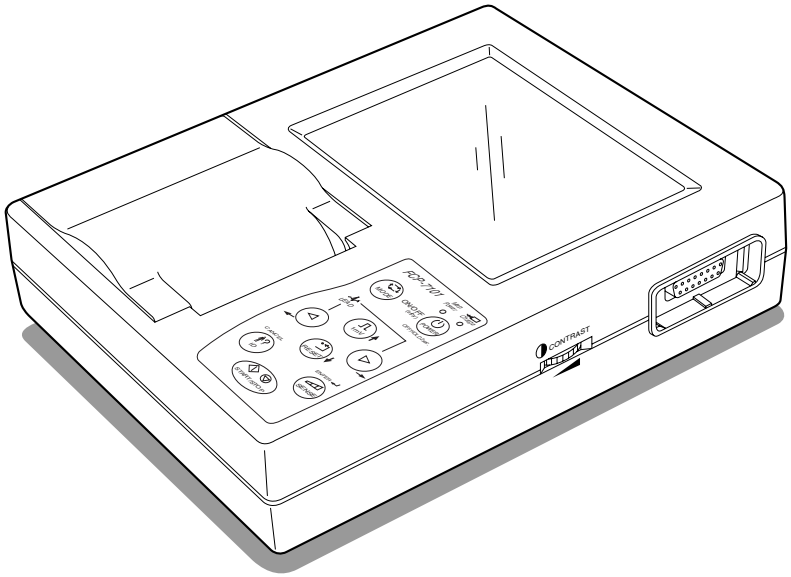
ELECTROCARDIOGRAPH

FCP-7101/FX-7102

Service Manual



- Before setting up/maintenance, please read this service manual carefully.
- Keep this manual where it can be always referred to.

FUKUDA DENSHI

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Notice

This manual contains technical information on the FCP-7101/FX-7102 aimed at Fukuda Denshi service representatives and professional engineers.
Before performing maintenance the unit, read the manual carefully and use it to help you work correctly and safely.
When you have finished using the manual, store it carefully in a designated location.

Strictly follow the instructions of this manual whenever you perform maintenance or make adjustments to the unit. Failure to do so may lead to a serious accident.

●Safety

This manual utilizes the graphic symbols shown below. Make sure that you understand the meaning represented by these symbols, carefully read the instructions given in the text, and work safely.

⚠DANGER
Failure to follow this message may result in death or serious injury to the patient or operator, damage to the equipment, or create a fire hazard.

⚠WARNING
Failure to follow this message may result in death or serious injury to the patient or operator.

⚠CAUTION
Failure to follow this message may cause injury to the patient, or may cause damage to the equipment.

Symbol	Description
NOTE	A note is not related to product safety. A note provides information about the proper use and operating method to prevent incorrect operation and trouble with the unit.
	Indicates an action that must not be performed.
	Indicates an action that must be performed.
REFERENCE	Indicates the reference page for the operation method.

●Servicing Precautions

In servicing the FCP-7101/FX-7102, observe the following.

⚠DANGER	
⃠	**Never remodel the medical electronic equipment. If remodelled, the equipment may not ensure safe operation, thereby causing accidental hazards to the patient and operator.**

⚠CAUTION	
❗	• The service manual is intended for the service engineers of Fukuda representatives and the technical staff concerned with medical electronic equipment. Servicing, reassembling, and adjustment shall be performed by autorized service engineers. • Prepare proper facilities and tools when servicing. • Be sure to follow the instructions of operation manual when operating the instrument. For operating precautions, refer to the operation manual.

⚠CAUTION

Disassembling/Reassembling Precautions

- Be sure to turn the power off and disconnect the power supply cord from the wall outlet. Then start disassembling the instrument.
- When removing the main PC board, remove the battery in advance.
- Take care not to disconnect and connect the key panel and sensor board from/to the connector too frequently. Too frequent disconnection and connection of these units may cause poor contact.
- Use proper screwdrivers to loosen screws.
- When reassembling, make sure all screws are tightened to original positions and all disconnected connectors are reconnected properly.

PC Board Handling Precautions

- PC boards are equipped with extremely sensitive devices to static electricity.
- PC boards are sensitive electronic assemblies. Take proper measures for removed PC boards, e.g. put them in a conductive bag.
- Handle PC boards carefully. Giving an impact to them may damage devices mounted onto them.
- Never remove a PC board or connect the connector to it when it is supplied with power.

⚠CAUTION

If you find a value which exceeds the allowable level, be sure to let the user avoid using the instrument. If the user operates the instrument as it is, he/she may receive an hazardous accident.

●Equipment Classification

The FCP-7101/FX-7102 is classified into the following equipment:

1. Protection against electrical shock
   Class Ⅱ, Internally powered
2. Type against electrical shock
   Applied part: Type CF
3. Degree of protection against harmful water invasion
   Ordinary equipment
4. Degree of safety in using under air-inflammable anesthetic gases or oxygen/nitrous
   oxide-anesthetic gases
   Equipment used under an environment containing no inflammable anesthetic gases or no inflammable cleaning agent.
5. Running mode
   Continuous running mode

Overview of the Manual

This manual consists of the following 9 chapters.
Contents of each chapter are briefly explained below.

Chapter 1 Component Names and Functions

The locations and functions of the unit's operation panel, switches, connectors, and other components. A list of specifications is also given.

Chapter 2 Troubleshooting

How to resolve problems that occur, using flowcharts for each symptom.

Chapter 3 Maintenance

Cleaning, test menu, program version updating, periodical inspection items, and methods.

Chapter 4 Disassembly

How to disassemble the unit in order to replace defective parts.

Chapter 5 Electric Circuit Diagrams

Electric circuit diagrams and diagrams of the connections between printed circuit boards.

Chapter 6 Spare Parts List

A list of components supplied as spare parts.

Chapter 7 Board Component Diagrams

The layout of the connectors and other mounted parts for each of the unit's printed circuit boards.

Chapter 8 Assembly Diagrams

The illustrations of the parts in three dimensional exploded views.
A list of the parts is also given.

Chapter 9 Technical Instructions Related to EMC

Technical instructions required by IEC60601-1-2 Ed.2 are described in this chapter.

Contents

Notice i
Safety i
Servicing Precautions ii
Equipment Classification iii
Overview of the Manual iv

Chapter 1 Component Names and Functions ..... 1—1
Unit (top face) ..... 1—1
Unit (side, rear, and bottom faces) ..... 1—2
Operation panel ..... 1—3
Specifications list ..... 1—5

Chapter 2 Troubleshooting ..... 2—1
On power supply in equipment (ECG AMP not included) 2-1
On ECG AMP supply voltage 2-2
Problem conditions and corrective action 2-3
Unit doesn't start up when main power is switched ON. 2-4
Battery operations are not executed. 2-4
Troubleshooting related to supply voltages 2-5
Failures related to charging operations 2-6
Charge error LED is lit 2-6
Charging operation ended normally, but the battery is nearly uncharged. 2-6
LCD does not display or display is abnormal. 2-7
Cannot perform key operations. 2-8
Does not detect mark on z-fold paper. Does not detect end of paper. Always displays "No recording paper" warning. 2-8
Date/time changes. 2-9
Buzzer would not sound 2-9
Recording paper is fed, but printing and waveform recording are not performed. 2-10
Recording paper is not fed 2-10
A certain lead record appears as a baseline. 2-10
All 12-lead patient records appear as baselines. 2-11
Detection of electrode misposition cannot be led. 2-11
Some leads do not detect electrode misposition. 2-11

Chapter 3 Maintenance ..... 3—1
Cleaning 3-1
Cleaning the unit 3-1
Replacing the battery 3-2
Update of the software 3-4
Self-diagnostics test 3-5
User self-diagnostics test 3-6
ECG Test Pattern 3-7
Recording Test 3-8
Key Test 3-9
LCD Test 3-10
Buzzer Test 3-11
Manufacturer self-diagnostics test 3-12
Status Test 3-14
ECG A/D DATA 3-15
LAN Test 3-16
Memory Test 3-17
ROM WRITE Test 3-18
Recorder Test 3-19

Memory initialize ····· 3-21
UPDATE ····· 3-22
Periodical inspections ····· 3-23
Periodical inspection intervals and precautions ····· 3-23
List of periodical inspection items ····· 3-23
Safety inspections (4 items) ····· 3-24
Before checking the leakage current ····· 3-24
Checking the enclosure leakage current (current that flows from the enclosure to the earth terminal of the power outlet) ····· 3-25
Checking the patient leakage current I ····· 3-25
Checking the patient leakage current III ····· 3-25
Checking the patient measurement current ····· 3-25
Inspection of electrical performance/characteristics ····· 3-26
Hardware inspections (10 items) ····· 3-28
Periodical inspection (2) record ····· 3-30

Chapter 4 Disassembly ····· 4—1
Removing the LCD ····· 4-1
Removing the enclosure cover ····· 4-2
Removing the recorder unit ····· 4-3
Removing the main board ····· 4-4

Chapter 5 Electric Circuit Diagrams ····· 5—1
Overall block diagram of unit (AC adapter not included) ····· 5-1
MAIN BOARD block diagram ····· 5-3
MAIN BOARD (PCB-6950) circuit ····· 5-5
1.Digital logic block ····· 5-5
CPU section ····· 5-5
FPGA section ····· 5-5
Memory section ····· 5-6
KEY I/F section ····· 5-8
Thermal head control section ····· 5-9
Real time clock ····· 5-10
Reset circuit section ····· 5-11
Sensor control section ····· 5-12
Motor control section ····· 5-13
LCD voltage generating section ····· 5-14
2.ECG AMP block ····· 5-15
3.Power supply block ····· 5-16
Power voltage generating section ····· 5-17
Battery charging section ····· 5-20
Power control section ····· 5-21
KEY BOARD (PCB-6949) circuit ····· 5-22
SENSOR BOARD (PCB-6948) circuit ····· 5-23
MAG UP BOARD (PCB-6951) circuit ····· 5-23
AC adaptor block diagram ····· 5-24
MAIN BOARD Circuit Diagrams (PCB-6950) ····· 5-25
Power connection table No.1 ····· 5-25
Power connection table No.2 ····· 5-26
POWER /CAPACITOR/RESET IC/CLOCK
LCD POWER block ····· 5-27
CPU block ····· 5-28
FPGA block ····· 5-29
MEMORY block ····· 5-30
LAN CONTROL block ····· 5-31
LCD I/F / RTC / LED block ····· 5-32
THERMAL I/F block ····· 5-33
SENSOR I/F /MAGAZIN UP SENSOR I/F
MOTOR I/F /JTAG I/F block ····· 5-34
ECG AMP block
(Differential amplification, multiplexer section) ····· 5-35
ECG AMP block (ADC,CPLD and POWER section) ····· 5-36

MAIN POWER SUPPLY +24V block ····· 5-37
CHARGE block ····· 5-38
+5V /+3.3V /+1.8V Power generation block ····· 5-39
POWER STATUS block ····· 5-40
POWER / CHARGE ERROR block ····· 5-41
+3.3VSTB / POWER ON RESET block ····· 5-42
BATTERY ON CONTROL / THERMAL POWER GENERATION BLOCK ····· 5-43
POWER-MAIN I / F block ····· 5-44
POWER ON / OFF CONTROL block ····· 5-45
KEY BOARD (PCB-6949) ····· 5-46
SENSOR BOARD (PCB-6948) ····· 5-47
MAG UP BOARD (PCB-6951) ····· 5-48

Chapter 6 Spare Parts List ····· 6—1
MAIN BOARD (PCB-6950) ····· 6-1
KEY BOARD (PCB-6949) ····· 6-8
SENSOR BOARD (PCB-6948) ····· 6-9
MAG UP BOARD (PCB-6951) ····· 6-10
Other spare parts list ····· 6-11

Chapter 7 Board Component Diagram ····· 7—1
MAIN BOARD (PCB-6950 component side) ····· 7-1
MAIN BOARD (PCB-6950 soldering side) ····· 7-2
KEY BOARD (PCB-6949 component side) ····· 7-3
KEY BOARD (PCB-6949 soldering side) ····· 7-4
SENSOR BOARD (PCB-6948 component side) ····· 7-5
MAG UP BOARD (PCB-6951 component side) ····· 7-6

Chapter 8 Assembly Diagrams ····· 8—1
Magazine ····· 8-1
Paper shaft ····· 8-2
Recorder ····· 8-3
Upper case (FCP-7101) ····· 8-4
Upper case (FX-7102) ····· 8-5
Lower case ····· 8-6
General assembly diagram (FCP-7101) ····· 8-7
General assembly diagram (FX-7102) ····· 8-8
Outline view (FCP-7101) ····· 8-9
Outline view (FX-7102) ····· 8-10
Paper guide ····· 8-11
50mm Magazine adapter (option) ····· 8-12
50mm Paper adapter (option) ····· 8-13

Chapter 9 Technical Instructions Related to EMC ····· 9—1
Emission information CISPR11 ····· 9-2
Immunity information (to other than radiation/conduction) ····· 9-3
Immunity information (to radiation/conduction) ····· 9-4
Recommended distance of separation from portable telephone, etc ····· 9-5

Chapter 1

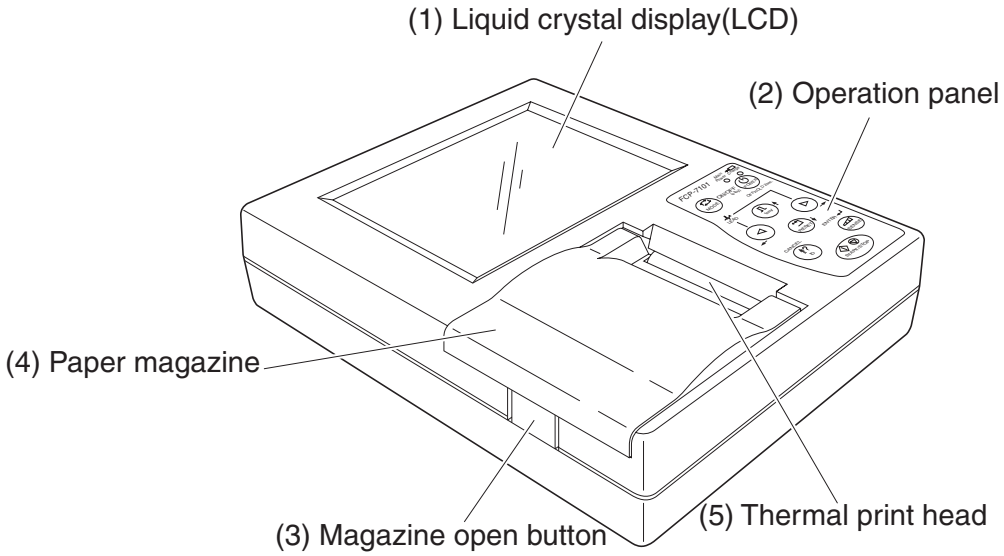
Component Names and Functions

Unit (top face) 1-1
Unit (side, rear, and bottom faces) 1-2
Operation panel 1-3
Specifications list 1-5

Chapter 1 Component Names and Functions

Unit (top face)

Liquid crystal display, operation panel, and paper magazine are provided on the top face of the unit.



(1) Liquid crystal display (LCD)

Displays electrocardiogram (ECG) waveforms, patient data, unit status, etc.

(2) Operation panel

Push the key switches on the panel to operate the electrocardiograph. Provided with the LED that indicates the operation status.

(3) Magazine open button

Push to open the magazine cover.

(4) Paper magazine

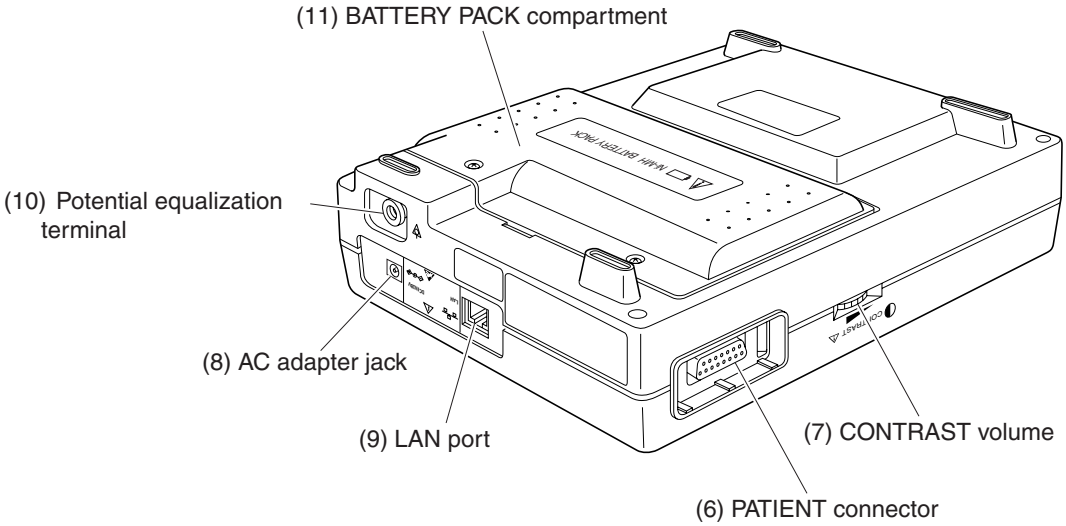
Load the recording paper here.

(5) Thermal print head

Records (prints) ECG waveforms and measured values.

Unit (side, rear, and bottom faces)

PATIENT connector and CONTRAST volume are provided on the side of the unit.
AC adapter jack, LAN port, and potential equalization terminal are provided on the rear face of the unit.
BATTERY PACK compartment is located on the underside of the unit.



(6) PATIENT connector

Plug in the patient cable here.

(7) CONTRAST volume

Use the volume to adjust the contrast of the LCD.

(8) AC adapter jack

Plug in the DC plug here.

(9) LAN port

Plug in the LAN cable here to communicate with a PC.

(10) Potential equalization terminal

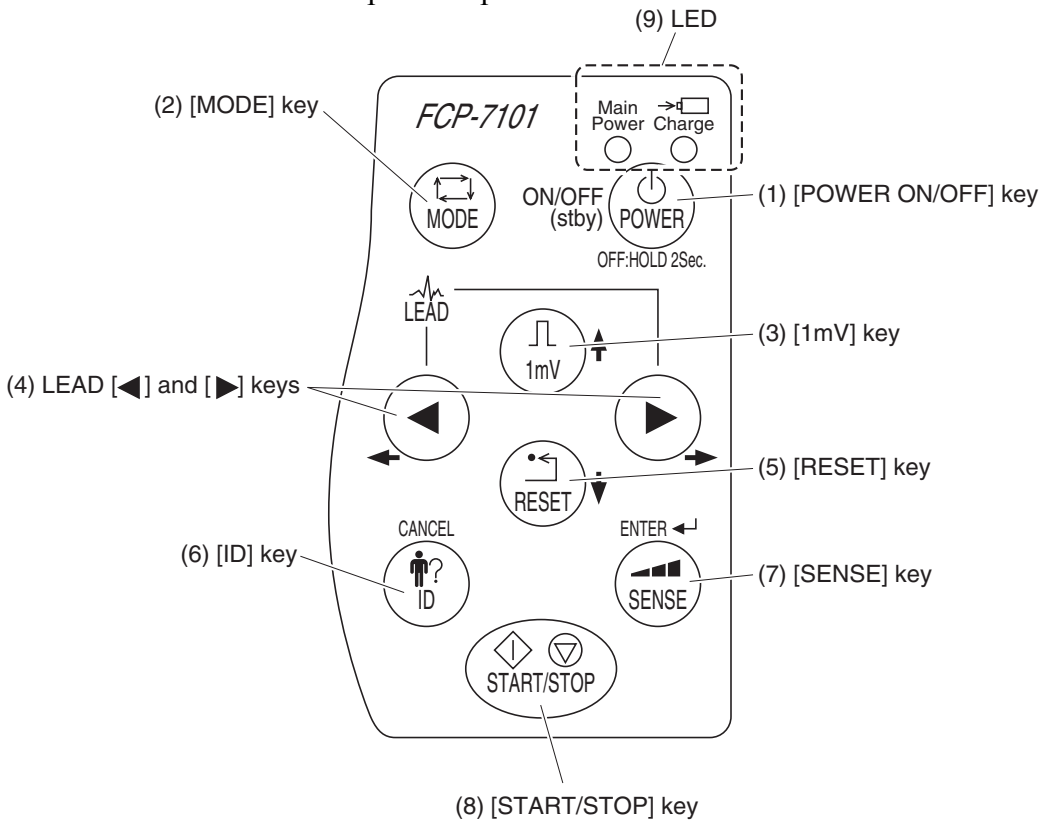
Plug in the ground cable here.

(11) BATTERY PACK compartment

Install the optional battery pack (8PH-4/3A3700-H-J18) in this compartment.

Operation panel

The electrocardiograph can be operated on the operation panel. The LED that indicates the operation status is at the upper right-hand corner of the operation panel.



(1) [POWER ON/OFF] key

Turns ON/OFF the power.
If AC power is set to OFF, charging of the battery, if provided, is started.

(2) [MODE] key

Press this key to select diagnosis mode and setting.

(3) [1mV] key

Press this key to display and record waves calibrated in 1mV.
The key moves the cursor upward on the setting screen.

(4) LEAD [◀] and [▶] keys

Press these keys to change the leads to be monitored.
The key moves the cursor horizontally on the setting screen.

(5) [RESET] key

Press this key to reset the ECG waveform to baseline state.
The key moves the cursor downward on the setting screen.

(6) [ID] key

Press this key to enter ID. The key serves as the CANCEL key on the setting screen.

(7) [SENSE] key

Press this key to change the sensitivity of the ECG. The key serves as the ENTER key on the setting screen.

(8) [START/STOP] key

Press this key to start/stop the recording, etc. of various data.

(9) LED

Displays the following operation status.

Status of LED	Operation of ECG
Main Power LED lit in blue.	Stays on while DC plug is connected to the equipment.
Charge LED lit in blue.	Battery charging underway.
Charge LED lit in yellow.	Charging abnormally terminated.

Specifications list

Electro-cardiography	Lead	Standard 12 leads
	Standard sensitivity	10mm/mV
	Sensitivity selection	1/4, 1/2, 1, 2, Auto
	Polarization voltage	±550mV or higher
	Frequency response	0.05 to 150Hz
	Transient characteristics (Time constant)	3.2 sec.
	Common mode rejection	103dB or more (Standard sensitivity 22mmp-p or lower)
	Input impedance	50MΩ or greater
	Input circuit current	5×10^{-8}A or lower
	Internal noise	20μVp-p or lower
	Calibrated voltage	1mV±2% or lower
	Amplifier composition	8ch (II, III, V1 to V6) Amplifier system
	A/D conversion	13 bits
	Sampling rate	1000/sec/ch
	Filter	HUM filter: 50 or 60Hz (−20dB or less) Muscle filter: 25 or 35Hz (−6dB/Oct) Drift filter: 0.25 or 0.5Hz (−6dB/Oct) High cut filter: 75Hz, 100Hz or 150Hz (−6dB/Oct)
	Recording system	Thermal array head
	Recording speed	5, 10, 12.5, 25, 50mm/sec.
	Recording resolution	Deflection axis: 8 dots/mm Time axis: 1msec.
	Recording channels	1ch, 3ch
	Recording paper	Rolled paper: OP-119TE (63mm×30M) Rolled paper: OP-18TE (50mm×30M) Z-fold paper: OP-122TE (63mm×20M) Z-fold paper: OP-123TE (50mm×20M)
	Display	FSTN LCD (320×240 dots)
	Display contents	Cardiograms, patient data, analysis and observation, error message
	Patient data	ID number, age, sex.
	Key panel	9 keys
Signal I/O	LAN port	10BASE-T compliant
Measurement operation	Basic measurement value	Heart rate, R-R time, etc.
General	Safety	Class Ⅱ type CF and internally powered equipment, type CF
	Power supply	AC power supply: AC adaptor, 100 to 240V AC (±10%), 50/60Hz DC power supply: 9.6V DC (Battery pack)
	Power consumption (Max.)	At AC operation: 70 VA At DC operation: 40 W
	Dimensions (W×D×H)	180×225×50mm (Projection not included)
	Weight	1.2kg±0.5kg (Battery included)
Operating environment	Temperature	10 to 40°C
	Humidity	25 to 95% (Condensation not allowed)
	Atmospheric pressure	70 to 106kPa (700 to 1060mbar)
Storage environment	Temperature	−10 to +50°C
	Humidity	10 to 95% (Condensation not allowed)
	Atmospheric pressure	70 to 106kPa (700 to 1060mbar)

Chapter 2

Troubleshooting

On power supply in equipment (ECG AMP not included)..... 2-1
On ECG AMP supply voltage..... 2-2
Problem conditions and corrective action..... 2-3
Unit doesn't start up when main power is switched ON..... 2-4
Battery operations are not executed. 2-4
Troubleshooting related to supply voltages 2-5
Failures related to charging operations 2-6
Charge error LED is lit..... 2-6
Charging operation ended normally, but the battery is nearly uncharged. 2-6
LCD does not display or display is abnormal. 2-7
Cannot perform key operations. 2-8
Does not detect mark on z-fold paper. Does not detect end of paper. Always displays "No recording paper" warning. 2-8
Date/time changes. 2-9
Buzzer would not sound 2-9
Recording paper is fed, but printing and waveform recording are not performed..... 2-10
Recording paper is not fed 2-10
A certain lead record appears as a baseline. 2-10
All 12-lead patient records appear as baselines. 2-11
Detection of electrode misposition cannot be led. 2-11
Some leads do not detect electrode misposition. 2-11

Chapter 2 Troubleshooting

On power supply in equipment (ECG AMP not included)

The following concerns the supply voltages in the equipment.

This equipment generates various DC power supply voltages (+24, +5, +5VSTB, +3.3V, +3.3VSTB, +1.8V and −24V) inside using the DC power supply, +18V, output by the attached AC adaptor or the DC power supply of the battery.
If the following power is not supplied, the intended functions by that power do not work.
If +3.3V, is not supplied, the CPU and FPGA do not operate, whereby all functions are inoperable.

DC power +18V from AC adaptor or battery pack voltage

- **+24V:** Supplied to the thermal head and the motor driver. Generates +3.3VSTB.
  - +3.3VSTB: Standby power used when DC plug is inserted or the Battery is set.
- **+5V:** Used as LCD logic drive voltage or mark sensor drive voltage. Generates +1.8V.
  - **+1.8V:** Used as the core power for CPU and FPGA.
- **+5VSTB:** Standby power used when DC plug is inserted.
- **+3.3V:** Supplied to the CPU, FPGA, memory, control/logic IC, crystal oscillator, sensor, etc. Generates −24V.
  - **−24V:** Used as LC voltage VEE of LCD.

On ECG AMP supply voltage

Since the ECG AMP is insulated, power is supplied through the push-pull circuit with a pulse transformer (FT-2155).

+5V

- **VTRF:** Main power supply of the ECG AMP. Generated through the pulse transformer (FT-2155). Generates +5VDF (+2.5VF) and +3.3VDF.
  - **+5VDF (+2.5VF):** Used mainly as the power supply for the differential amplifier or photocoupler.
  - **+3.3VDF:** Used as the power supply to drive the CPLD for the ECG AMP.

Problem conditions and corrective action

⚠CAUTION
If any part mounted on the MAIN BOARD (PCB-6950) or other circuit boards seems to be faulty, replacing not the part itself only but the entire circuit board is recommended.

⚠CAUTION
When checking the circuit voltage and signals to correct a problem, be careful not to cause a short circuit.

●Unit doesn't start up when main power is switched ON.

Item to Check	Method of Checking and Corrective Action	Place to Check
Power cable	Check that the power cable is plugged into the power outlet and the AC adaptor. Check that the DC plug is connected to the equipment.	Power cable DC plug
LED on the operation panel Cable	Connect the DC plug and check that the [Main Power] LED on the operation panel is kept ON. If not, check the KEY cables connecting the operation panel and the MAIN BOARD for a break, etc.	[Main Power] LED on the operation panel KEY cable
Fuse	Using a voltmeter, check that F6 fuse is not blown.	F6 REFERENCE P5-37
Checking the voltage on MAIN BOARD	Using a voltmeter, check that +18V, +5V, +3.3V, +1.8V, +3.3VSTB, and +5VSTB are present at C100, C311, C312, C317, C314, and C310 terminals of the MAIN BOARD. When +5V or +3.3V is present, LED4 or LED5 is lit.	C100, C310, C311, C312, C314, C317 LED4, LED5 REFERENCE P5-37,39
AC adaptor	Check that the LED of the AC adaptor is lit. Using a voltmeter, check that +18V is present at DC plug terminal.	LED of AC adaptor DC plug

●Battery operations are not executed.

Item to Check	Method of Checking and Corrective Action	Place to Check
Battery connection	Open the battery compartment cover, and verify that the battery pack is securely connected	Battery compartment REFERENCE P3-2
Checking the charge	After the end of charging the battery, start the operation using the battery. If the operation is impossible or soon fails, the battery is deteriorated. Replace the battery with a new one.	Starting after charging.
Fuse	Using a voltmeter, check that F3 fuse is not blown.	F3 REFERENCE P5-37
Checking the voltage on MAIN BOARD	Using a voltmeter, check that the battery pack voltage, +5V, +3.3V, +1.8V, and +3.3VSTB are present at C100, C311, C312, C317, and C314 terminals of the MAIN BOARD. When +5V or +3.3V is present, LED4 or LED5 is lit.	C100, C311, C312, C314, C317 LED4, LED5 REFERENCE P5-37,39

● Troubleshooting related to supply voltages

* The following troubleshooting assumes that the fuses F6 and F3 are not blown. Check fuses first when you have a trouble with the supply voltage.

Item to Check	Method of Checking and Corrective Action	Place to Check
+3.3V	Check that +3.3V is applied to terminal C312 on the MAIN BOARD. Check also that LED5 is kept ON. If voltage is not applied, +24V may not be supplied or IC46 may be faulty.	C312 LED5 IC46 REFERENCE P5-37,39
+3.3STB	Connect the DC plug without starting the equipment, and check that +3.3V is applied to terminal C314 on the MAIN BOARD. If not, +18V may not be supplied or IC62 may be faulty.	IC62 REFERENCE P5-42
+1.8V	Check whether or not +1.8V is applied at terminal C317 on the MAIN BOARD. If not applied, check whether or not +5V is applied at IC45 pin 8. If not applied, refer to the remedy for absence of+5V. If voltage is applied, IC45 may be faulty.	C317 IC45 pin 8 REFERENCE P5-39
+5V	Check that +5V is applied to terminal C311 of the MAIN BOARD. Check also that LED4 is lit. If voltage is not applied, +24V may not be supplied, or IC47 may be faulty.	C311 LED4 IC47 REFERENCE P5-39
+5V STB	Check that +5V is applied to IC43 pin 1 of the MAIN BOARD. If not, IC43 may be faulty.	IC43 pin 1 REFERENCE P5-38
+24V	Check that +24V is applied to C101 terminal of the MAIN BOARD. If not, IC42 or Q25 may be faulty.	C101 IC42,Q25 REFERENCE P5-37
-24V(V_{EE})	Check that −24V is applied to P1 pin 12. Check also that +3.3V is applied to IC1 pin 6. If not, see troubleshooting for absence of +3.3V. If +3.3V is applied, IC1 or IC7 (CPU) may be faulty.	P1 pin 12 IC1 pin 6 IC7 pin 13 REFERENCE P5-32,27,28
VTRF	Check that +6.2V is applied to C274 terminal. If not, T1 (FT2155) may be faulty. Check that 125kHz rectangular waves are input to IC20 pins 13 and 15. If not, IC8 (FPGA) may be faulty.	C274 T1 IC20 IC8 REFERENCE P5-36,29
+5VDF(+2.5VF)	Check that +5V is applied to C275 terminal. If not, VTRF may not be generated, or IC40 may be faulty.	C275 IC40 REFERENCE P5-36
+3.3VDF	Check that +3.3V is applied to C276 terminal. If not, IC39 may be faulty, or VTRF (about +6.2V) may not be applied to IC39 pin 6.	C276 IC39 REFERENCE P5-36

●Failures related to charging operations

Item to Check	Method of Checking and Corrective Action	Place to Check
Power cable	Check that the power cable is plugged into the power outlet and the AC adaptor. Check that the DC plug is connected to the equipment.	Power cable DC plug
Battery	Open the battery compartment cover on the botton of the unit. Verify that the battery is present and that the battery and unit are securely connected. Verify also that the connecting cable is not disconnected/broken.	Connection between the battery and unit Cable REFERENCE P3-2
Battery voltage	Check whether or not the battery voltage is +8.0 V or higher.	Battery voltage

●Charge error LED is lit

Item to Check	Method of Checking and Corrective Action	Place to Check
Battery voltage	Check whether or not the battery voltage is +14.4 V or higher	Battery voltage
Battery temperature	Detach the battery from the equipment, and check whether the battery is excessively hot or not. The charge error LED comes on if the battery temperature exceeds 70°C.	Battery temperature REFERENCE P3-2

●Charging operation ended normally, but the battery is nearly uncharged.

Item to Check	Method of Checking and Corrective Action	Place to Check
Battery	The number of charge and discharge cycles of battery is about 300 although it depends on the particular operating environment. The duration in hours after charging shortens as the number of discharges increases. If the battery cannot hardly be charged, replace it.	Battery

●LCD does not display or display is abnormal.

Item to Check	Method of Checking and Corrective Action	Place to Check
Contrast	Operate the contrast control knob to adjust the LCD brightness.	Contrast adjusting knob REFERENCE P1-2
Connector	Verify that the flat cable of the LCD unit and P1 on the KEY • LCD I/F board is securely connected. Verify also that the flat cable is inserted in the correct direction and is free of cuts and separation.	Flat cable of LCD unit and P1 REFERENCE P5-32
Power supply	Check the voltage for the main board. ・ V_{SS}: P1 (11 and 14 pins) GND level ・ V_{DD}: P1 (10 pins) +5V If V_{SS} or V_{DD} is abnormal, refer to the section of +5 V in "Troubleshooting related to supply voltages".	P1 pins 11,14 P1 pins 10 REFERENCE P2-4, P5-32
Control signals	Verify that LCD control signals FLM,CL1,CL2 and D0-3 are not at the H or L fixed levels. Verify also that the DISPOFF* signal is at the H level. The LCD module is controlled by IC7(CPU); thus, if the control signal is abnormal, IC7 is likely to be defective.	P1 Pins 1 to 4 and pins 6, 8, 9 IC7 REFERENCE P5-28, 32
Liquid crystal voltage V_{EE}	Check the voltage on P1 pins 12. ・ V_{EE} P9 (pins A24, A25) V_{EE}. V_{EE} is a liquid crystal drive voltage. The LCD contrast is controlled in terms of this voltage. The voltage depends on the operation circumstances. Operate the contrast adjusting knob to see if the voltage is between +21 and +24 V. If V_{EE} is abnormal, refer to the section of V_{EE} in "Troubleshooting related to supply voltages". Also check the action of Q1 area.	P1 pins 12 Q1 REFERENCE P2-4, P5-32 P5-27

●Cannot perform key operations.

Item to Check	Method of Checking and Corrective Action	Place to Check
Cable	Check that the KEY cable is connected to P2 and the KEY BOARD. Check that the parts around P2 are properly mounted.	P2 Key cable REFERENCE P5-32
Key signal	Check that the signal corresponding to the key pressed is at "L" level.	P2 pins 3 to 10. Key scan signal REFERENCE P5-32

●Does not detect mark on z-fold paper. Does not detect end of paper. Always displays "No recording paper" warning.

Item to Check	Method of Checking and Corrective Action	Place to Check
Program setting	Check whether the recording paper is set at roll paper or not.	Program setting (recording paper)
Sensor	Verify that the mark sensor area is free of foreign matter and that the sensor is securely attached.	Mark sensor
Connector	Verify that the sensor cable is securely connected and not broken. Verify also that the soldering of the connector P6 on the MAIN BOARD is free of defect.	P6 REFERENCE P5-34
Mark drive signal	Check that 2kHz rectangular waves are input to P6 pin 4. If not, IC8 or IC20 may be faulty.	P6 pin 4, IC8, IC20 REFERENCE P5-29, 34
Detection signal	At a status where the magazine is closed and other than a mark on the recording paper is aligned with the sensor, check whether or not the waveform coming from IC16 pin 7 is 2 kHz. If the above signal is not detected, check the mark sensor and mark drive signals.	IC16 pin 7, Mark sensor REFERENCE P5-34

●Date/time changes.

The clock function is performed by lithium battery (BT1) at all times. The setting of the equipment is backed up for about 5 years, on condition that it is stored at the room temperature.

Item to Check	Method of Checking and Corrective Action	Place to Check
Lithium battery voltage	Check that the voltage of the lithium battery (BT1) is +2V or higher. Check also that the battery is properly mounted to the MAIN BOARD.	RT1 REFERENCE P5-32
Control signal	Verify that RTCCE, RTCDATA, and RTCCLK signals on the IC13 do not become fixed at H or L each time the date/time is changed in the program settings.	IC13 pin 11,12,13 REFERENCE P5-32

●Buzzer would not sound

Item to Check	Method of Checking and Corrective Action	Place to Check
Program setting	Check the program setting to make sure that the buzzer is not set to OFF, or the volume is set to extremely low setting.	Program setting of the buzzer
Buzzer	Check that the buzzer (Y1) is properly mounted to the MAIBN BOARD.	Y1 REFERENCE P5-29
Buzzer signal	With an oscilloscope, observe the potential at IC8 pin 103 while the buzzer is sounding, and make sure it is not a fixed potential.	IC8 pin 103 REFERENCE P5-29

●Recording paper is fed, but printing and waveform recording are not performed.

Item to Check	Method of Checking and Corrective Action	Place to Check
Connector	Verify that the thermal print head cable is securely attached to connector P3 on the MAIN BOARD. Verify also that the soldering of connectors P3 is free of defect. Verify that the thermal print head and thermal print head cable are securely connected and that the thermal print head cable is not broken.	P3 Thermal print head cable REFERENCE P5-33
Power supply	Verify that pins No. 1, 2, 13 and 14 of P3 on the POWER BOARD are supplied with +24 volts during recording.	P3 pins 1, 2, 13and 14 REFERENCE P5-33
Control signal	When recording, verify that the signals of [LATCH*] (pin No. 10), [CLOCK] (pin No. 9), and [STROBE1*-4*] (pins No. 7and8) of P3 on the MAIN BOARD are not fixed at "H" or "L." If the above is abnormal, check the signals for IC7B to IC8, 56-59.	P3 pins 7 to 10 IC8pins 56 to59 REFERENCE P5-29,33
Overheat	Printing is not performed if the temperature of the thermal head is 60°C or higher. Check that IC15 pin 7 is not at “L” level. Check the maker maintenance status to make sure that the temperature of the thermal head is not set to 60°C or higher.	IC15 pin 7 Maker maintenance status REFERENCE P5-33, P3-14

●Recording paper is not fed

Item to Check	Method of Checking and Corrective Action	Place to Check
Connector	Check that the motor cable is securely connected and that it is not broken.	P5 Motor cable REFERENCE P5-34
Control signal	While recording, check that a signal is present at P5 pins 1 through 4 on the MAIN BOARD. Also check that the level is not "L" at Q6 and Q7 pins 3. If a signal is present, the motor may be faulty.	P5 REFERENCE P5-34

●A certain lead record appears as a baseline.

Item to Check	Method of Checking and Corrective Action	Place to Check
Patient cable	Check the patient cable. for a break and check the connection staus.	Patient cable
OP Amp of ECG AMP, A/D converter and limiter	Check that the operation of the OP Amp, IC23 to IC27, and A/D converter IC37 (which are related to the baseline lead) and the transistors Q13 to Q21 for the protection against excess input are not shorted.	IC23 to IC27, IC37,Q13 to Q21 REFERENCE P5-35,36

●All 12-lead patient records appear as baselines.

Item to Check	Method of Checking and Corrective Action	Place to Check
Control signal	Check that 125kHz rectangular waves are input to IC20 pin 13. Check also that reversed rectangular waves are input to IC20 pin 15.	IC20 pins 13, 15 REFERENCE P5-36
Supply voltage of ECG AMP	Power may not be supplied. See troubleshooting on supply voltage (2-4 and 2-5).	REFERENCE P2-5
ECG AMP clock	Check that 8MHz rectangular waves are output from X2 pin 3. If not, X2 may be faulty.	X2 pins 3 REFERENCE P5-36
ECG AMP signal	Check that IC38 pins 5 and 7, [RXD] and [TXD], are not set to “H” or fixed to “L.”	IC38 pins 5 and 7 REFERENCE P5-36 “CPLD(IC38) peripheral circuit”

●Detection of electrode misposition cannot be led.

Item to Check	Method of Checking and Corrective Action	Place to Check
Patient signal of ECG AMP	Check the signal line (around IC23 and IC24) where electrode misposition occurred.	Signal lines of ECG AMP (around IC23 and IC24) REFERENCE P5-35

●Some leads do not detect electrode misposition.

Because of the high impedance circuit structure, the portion of ECG input that precedes the buffer IC is difficult to measure with an instrument. Thus, from a time standpoint, it is effective to determine faulty locations by replacing devices.

Item to Check	Method of Checking and Corrective Action	Place to Check
OP Amp	Under the condition where the electrode misposition occurs (patient cable disconnected, etc.), check that the output voltage of buffer OP Amp related to the lead not detecting the electrode misposition (IC23 and IC24) is approximately –2.5V.	IC23, IC24 REFERENCE P5-35
Multiplexer	Check if the electrode misposition signal is properly input to IC29.	IC29. REFERENCE P5-35
ECG AMP limiter	Under the condition where the electrode misposition occurs (patient cable disconnected, etc.), remove the transistors Q13 to Q21 for the protection against excess input related to the lead not detecting the electrode misposition, and check the operation.	Q13 to Q21 REFERENCE P5-35

Chapter 3

Maintenance

Cleaning 3-1
Cleaning the unit 3-1
Replacing the battery 3-2
Update of the software 3-4
Self-diagnostics test 3-5
User self-diagnostics test 3-6
ECG Test Pattern 3-7
Recording Test 3-8
Key Test 3-9
LCD Test 3-10
Buzzer Test 3-11
Manufacturer self-diagnostics test 3-12
Status Test 3-14
ECG A/D DATA 3-15
LAN Test 3-16
Memory Test 3-17
ROM WRITE Test 3-18
Recorder Test 3-19
Memory initialize 3-21
Update 3-22
Periodical inspections 3-23
Periodical inspection intervals and precautions 3-23
List of periodical inspection items 3-23
Safety inspections (4 items) 3-24
Before checking the leakage current 3-24
Checking the enclosure leakage current (current that flows from the enclosure to the earth terminal of the power outlet) 3-25
Checking the patient leakage current I 3-25
Checking the patient leakage current III 3-25
Checking the patient measurement current 3-25

Inspection of electrical performance/characteristics.....3-26
Hardware inspections (10 items).....3-28
Periodical inspection(2) record.....3-30

Chapter 3 Maintenance

Cleaning

●Cleaning the unit

Moisten gauze or absorbent cotton with medicinal alcohol or neutral detergent, and wring tightly; then wipe off the enclosure.

⚠CAUTION	
⃠	● **Prevent chemicals and other liquids from getting inside the unit and connectors. Electrical equipment can short and get damaged.** ● **Do not use detergents containing organic solvent, thinner, toluene, benzene, and similar substances. They can damage resins. Do not use them.** ● **Do not use abrasives or chemical cleaners either.** ● **When using chemical sprays to disinfect entire rooms, take steps to prevent chemicals from adhering to the unit's internal components and connectors. Shorting of electrical parts can cause damage, and poor connections can cause malfunctions.**

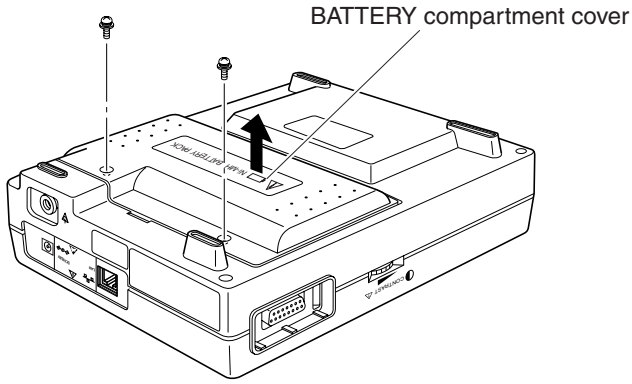
Replacing the battery

⚠DANGER
Before replacing the battery, make sure to turn the power OFF and unplug the power supply cord from the AC adapter.

1. Turn OFF the main power switch of the unit and unplug the DC plug.

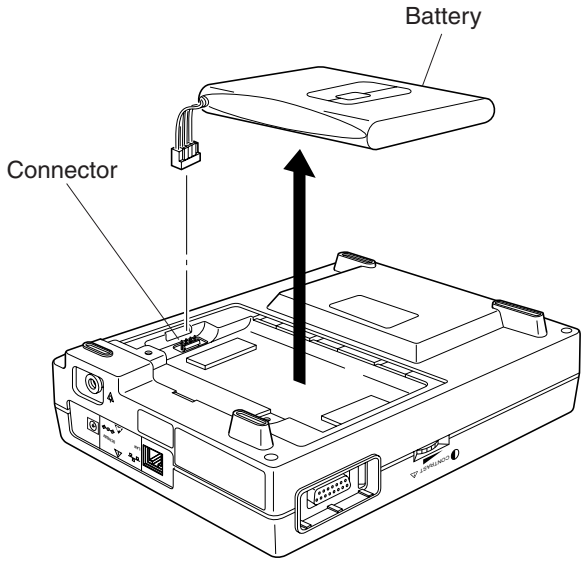
2. Remove the battery compartment cover.

   Remove two screws tightening the battery compartment cover at the bottom of the unit.



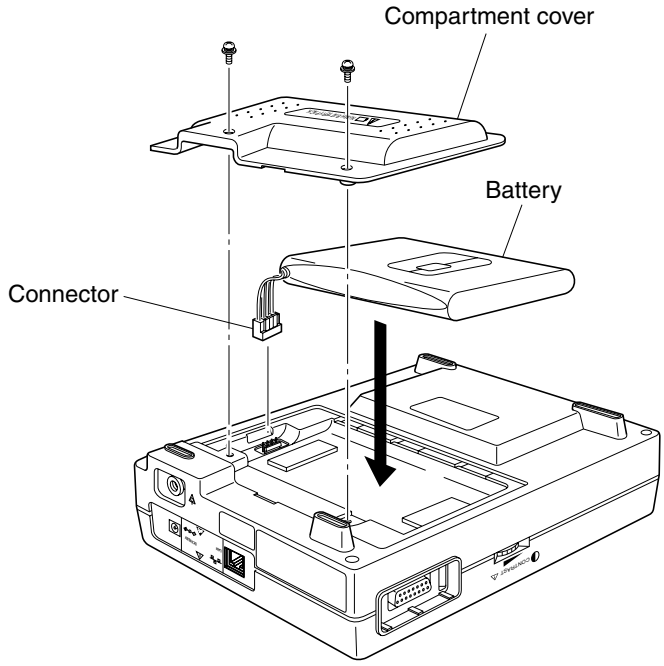
3. Remove the battery.

   Take out the battery cable connector from the power supply terminal located in the battery compartment. Then, remove the battery.



4. Install a new battery.

   Insert the battery cable connector to the power supply terminal, and place the battery inside the battery case and mount the battery compartment cover.



NOTE

If the battery compartment cover does not fit well, reinstall the battery and battery cable in the battery case.

5. After replacing and charging the battery, disconnect the DC plug, and then turn ON the main power switch to make sure that the unit starts up normally.

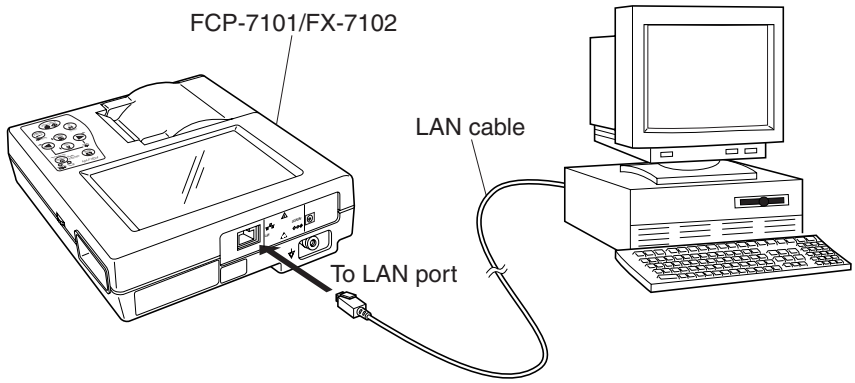
NOTE

Charge the battery first after replacing it. Capacity of the battery stored for a long time has lowered due to self-discharge. Depending on the remaining charge of battery, charging may not start.

Update of the software

The software can be updated by communication through LAN. To update the software, it must be installed in the PC in advance.

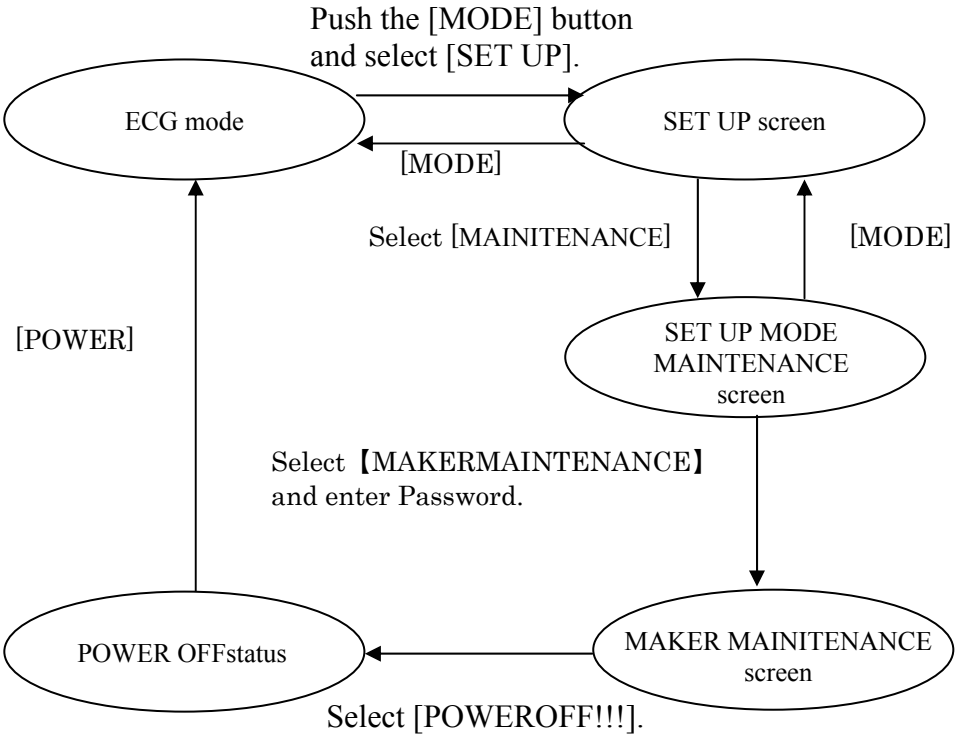
1. Connect the LAN port of the equipment and the PC with a LAN cable.



2. Carry out PROGRAM UPDATE of MAKER MAINTENANCE. (See manufacturer self-diagnosis test.)

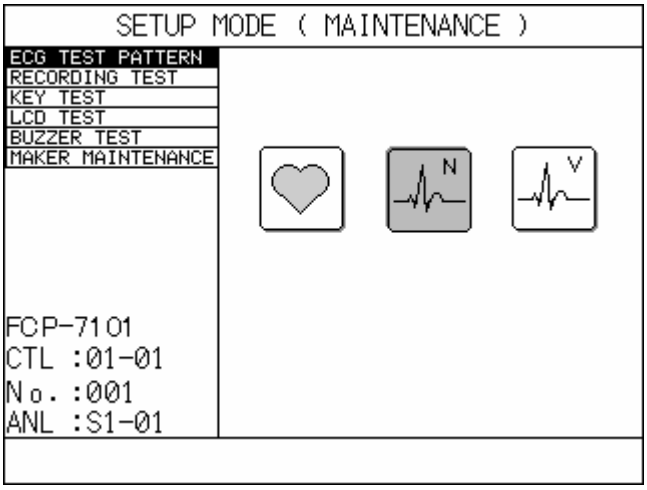
Self-diagnostics test

The self-diagnostics test function is classified into two types: user self-diagnostics test and manufacturer self-diagnostics test.
The user self-diagnostics test is used for a daily check by the user.
The manufacturer self-diagnostics test is used for checking and adjusting the unit in a production process or during product inspection, and for the maintenance by the manufacturer.
To carry out the manufacturer self-diagnostics, the password must be entered.



●User self-diagnostics test

Push the [MODE] key and select [SET UP] using the [→] key. Push the [↓] key to display the pull-down menu. Select [MAINTENANCE] from the menu using the [↑] [↓] key. Then push the [ENTER] key, and the [SETUP MODE (MAINTENANCE)] screen is displayed. Select a desired user self-diagnostic menu using the [↑] [↓] key, and a corresponding diagnosis screen is displayed.



The following user self-diagnostic test menus are available.

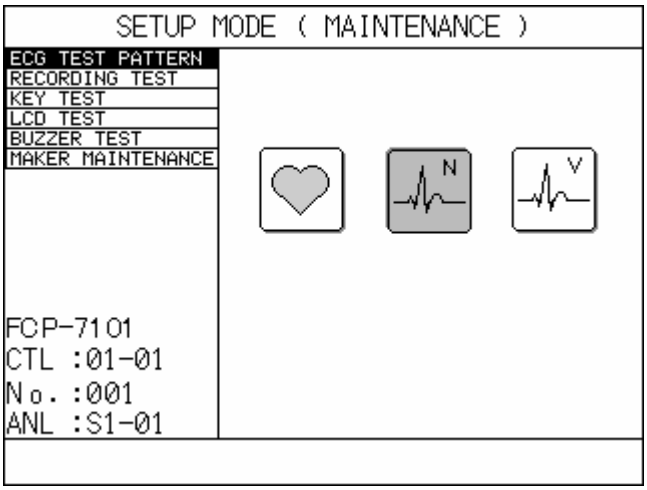
- ECG TEST PATTERN
- RECORDING TEST
- KEY TEST
- LCD TEST
- BUZZER TEST

Push the [MODE] key to return to the SETUP pull-down menu selection screen.

ECG Test Pattern

This section explains how to select the built-in electrocardiogram (ECG) test pattern waveform to use during an operation check or demonstration.

1. Select [ECG TEST PATTERN] on the [SETUP MODE (MAINTENANCE)] screen, and the ECG TEST PATTERN selection screen is displayed.



2. Select a desired test pattern using the [←] or the [→] key, and push the [MODE] key to return to the inspection.

3. The following test patterns are available.

Pattern	Description
	Test pattern waveform is invalidated.
	Normal pattern waveform
	Irregular heartbeat pattern PVC

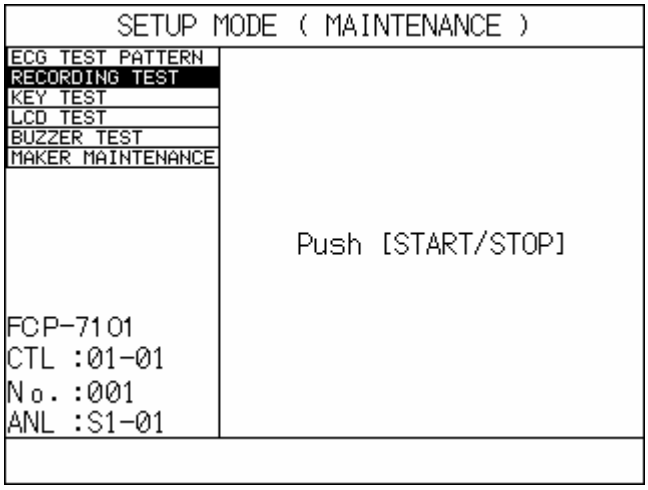
NOTE

Since test pattern information is not backed up, [NONE] is always selected at the time of power ON.

Recording Test

This test is performed to check the recording status.

1. Select [RECORDING TEST] on the [SETUP MODE (MAINTENANCE)] screen, and the diagnosis screen is displayed. Push the [MODE] key to return to the SETUP pull-down menu selection screen.



2. Push the [START/STOP] key to start a recording test. Press the [START/STOP] key once again to stop the recording test.

3. Push the [START/STOP] key, and the format shown by Fig. 1 is printed at the transfer speed of 5mm/sec, 10mm/sec, 12.5mm/sec, 25mm/sec and 50mm/sec in that order. The format shown by Fig. 2 is then printed at the transfer speed of 50mm/sec.

NOTE

The recording test in progress is discontinued when the [START/STOP] key is pressed. If the [START/STOP] key is not pressed, the total recording test terminates when the recording of diagonal line format (25mm/sec.) is completed.

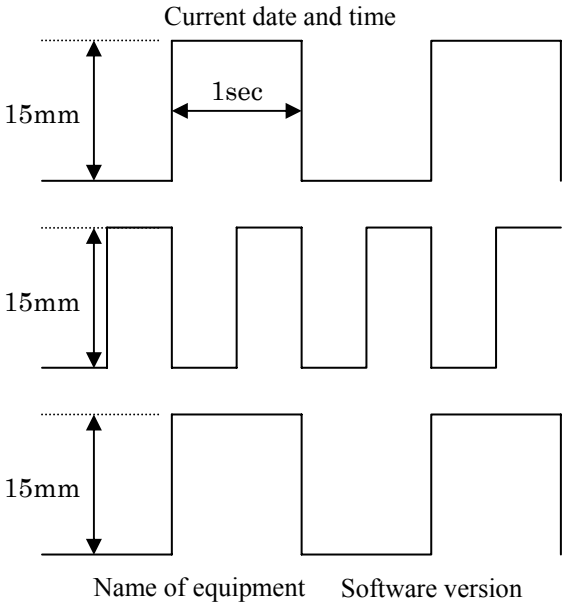


Fig1

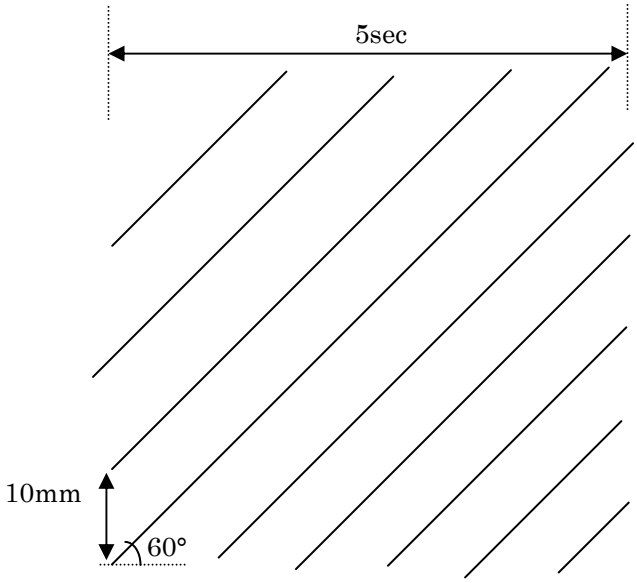


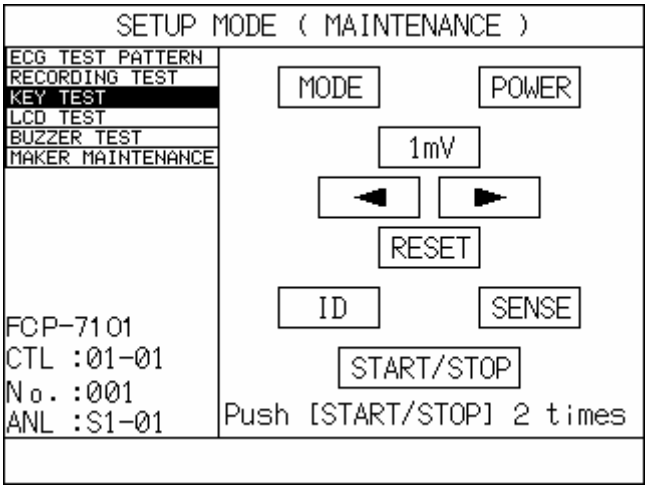
Fig2

Key Test

This test is performed to check the key operation.

1. Select [KEY TEST] on the [SETUP MODE (MAINTENANCE)] screen, and "Push [START/STOP] 2 times" message appears. Push the [MODE] key to return to the SETUP pull-down menu selection screen.

2. Press the [START/STOP] key twice, and the key test window appears and the key test is started.



3. Push a key on the operation panel, and the pushed key is highlighted on the LCD. Push the [START/STOP] key twice to terminate the key test.

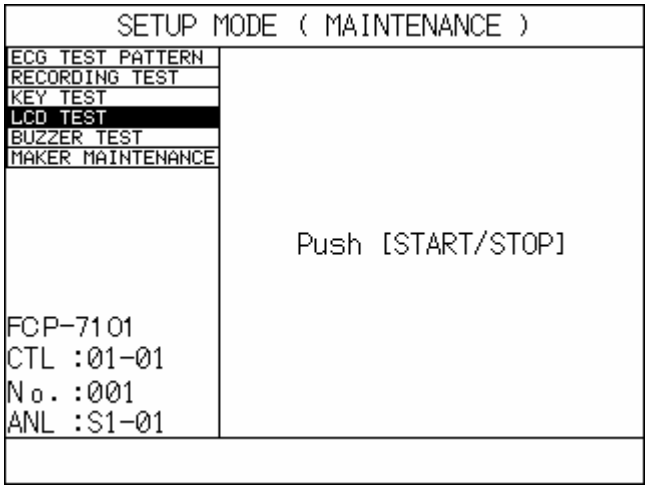
NOTE Press down the [POWER] key during the key test to turn off the power.

LCD Test

This test is performed to check the LCD for missing dots, its gradation, etc.

1. Select [LCD TEST] on the [SETUP MODE (MAINTENANCE)] screen, and the diagnosis screen is displayed. Push the [MODE] key to return to the SETUP pull-down menu selection screen.

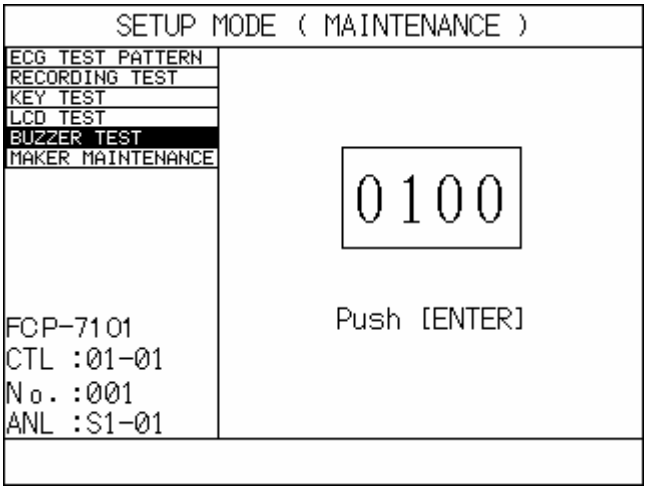
2. Push the [START/STOP] key to start the LCD test. The screen returns to the [SET UP MODE (MAINTENANCE)] screen on termination of LCD display.



Buzzer Test

This test is performed to check the tone, volume, etc. of the speaker.

1. Select [BUZZER TEST] on the [SETUP MODE (MAINTENANCE)] screen, and the diagnosis screen is displayed. Push the [MODE] key to return to the SETUP pull-down menu selection screen.



2 Push the [ENTER] key, and the buzzer sounds. Press the [ENTER] key once again to stop the buzzer sound.

3 By pushing the [↑] [↓] key while the buzzer is sounding, the tone can be changed arbitrarily.

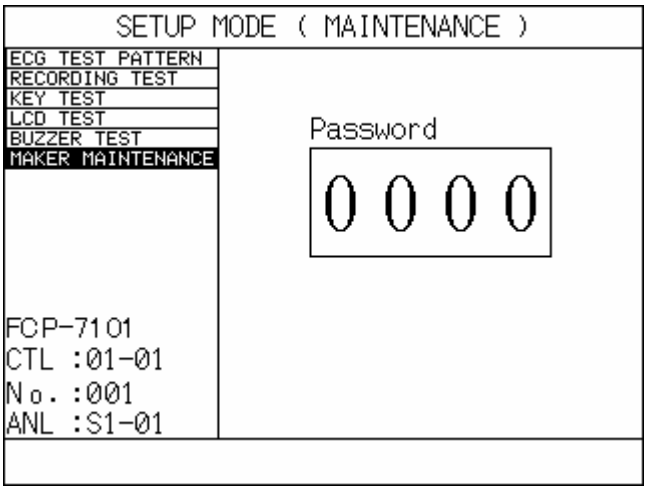
●Manufacturer self-diagnostics test

Select [MAKER MAINTENANCE] on the [SETUP MODE (MAINTENANCE)] screen and enter the password, and the [MAKER MAINTENANCE] screen is displayed. Manufacturer self-diagnostic test can be performed on this screen. Manufacturer self-diagnostic test is usually performed by the personnel of the manufacturer in charge of maintenance. The following tests can be performed as manufacturer self-diagnostic tests.

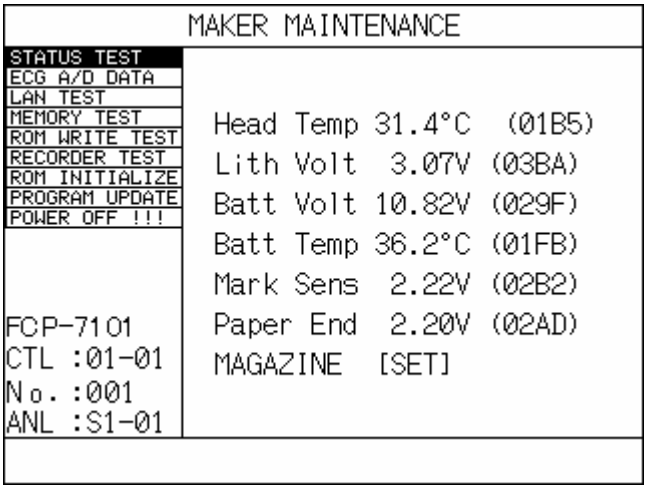
- STATUS TEST
- ECG A/D DATA
- LAN TEST
- MEMORY TEST
- ROM WRITE TEST
- RECORDER TEST
- ROM INITIALIZE
- PROGRAM UPDATE

Enter the password as follows.

1. Select [MAKER MAINTENANCE] on the [SETUP MODE (MAINTENANCE)] screen, and the following screen is displayed. Push the [MODE] key to return to the SETUP pull-down menu selection screen.



2. Enter the password (9001) using the up/down/right/left key and push the [ENTER] key, and the [MAKER MAINTENANCE] screen appears, allowing you to perform manufacturer self-diagnostic test. Select a desired diagnostic item to go to the corresponding diagnosis screen.



3. Push [POWER OFF!!!], and the ECG is turned off and the manufacturer self-diagnostic test is terminated.

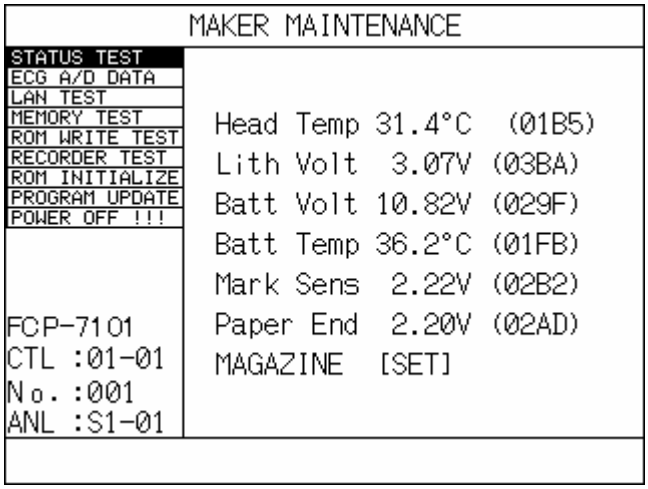
NOTE

You cannot return to the ECG mode screen in MAKER MAINTENANCE mode. To go to the ECG mode screen, turn off the power by selecting [POWER OFF!!!] and start the equipment once again..

Status Test

This test is performed to check the function of displaying each status of the hardware.

1. Select [STATUS TEST] on the [MAKER MAINTENANCE] screen, and the following screen is displayed.

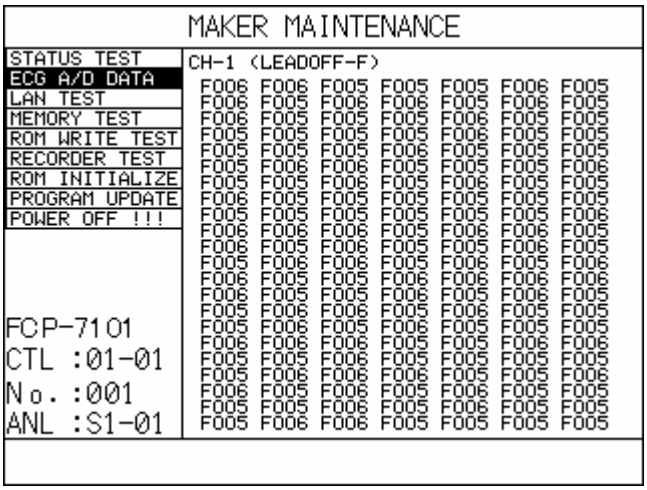


2. The following status information is displayed in [STATUS TEST].

   - Thermal head temperature
   - Lithium battery voltage
   - Battery voltage
   - Battery temperature
   - Mark sensor voltage
   - Sensor voltage for detection of paper out
   - Recorder status (magazine up)

ECG A/D DATA

The data (A/D value) input to ECG AMP can be displayed.

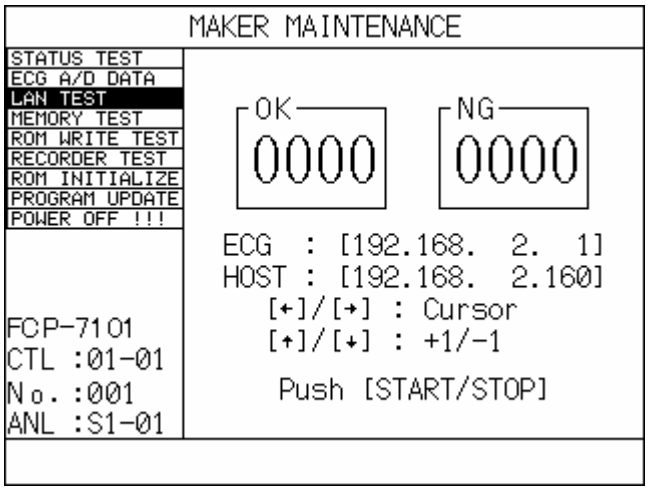


1. Press the [←] or the [→] key to switch channels.

LAN Test

This test is performed to check the function of the LAN.

1. Select [LAN TEST] on the [MAKER MAINTENANCE] screen, and the following screen is displayed.



2. Using the [←], [→], [↑], or the [↓] key, enter the IP address of the ECG and that of the HOST.

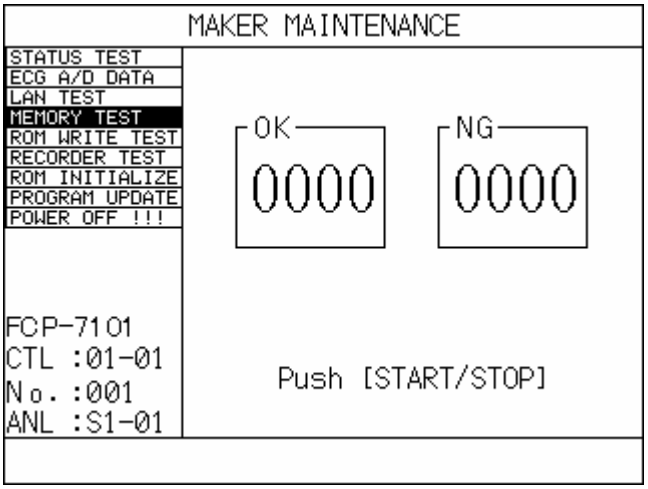
3. Connect the LAN cable to the LAN port and push the [START/STOP] key, and the LAN test is started.

4. Push the [START/STOP] key once again to terminate the LAN test.

Memory Test

This test is performed to check the read/write status of the SDRAM.

1. Select [MEMORY TEST] on the [MAKER MAINTENANCE] screen, and the following screen is displayed.



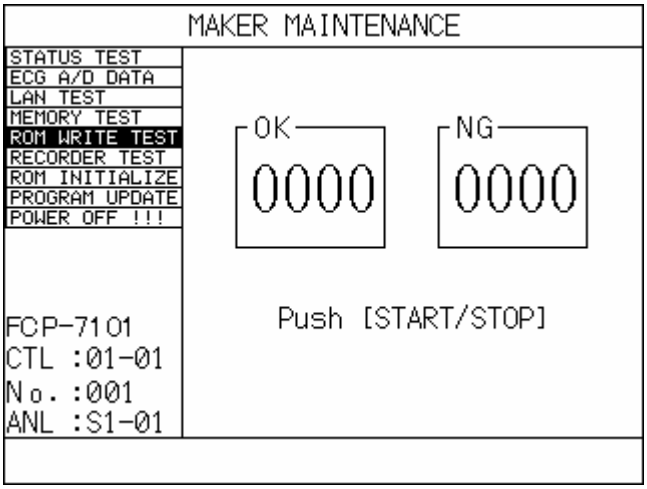
2. Push the [START/STOP] key to start the memory test.

3. Push the [START/STOP] key once again to terminate the memory test.

ROM WRITE Test

Read/write test of FLASH ROM can be performed.

1. Select [ROM WRITE TEST] on the [MAKER MAINTENANCE] screen, and the following screen appears.



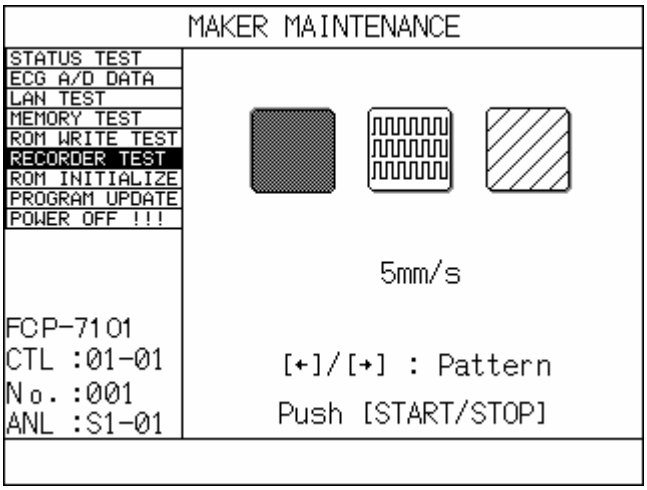
2. Push the [START/STOP] key to start the ROM WRITE TEST.

3. Push the [START/STOP] key once again to exit the ROM WRITE TEST.

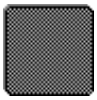
Recorder Test

The recorder test is a function of checking the thermal head for missing dots and verifying the printing condition.

1. Select [RECORDER TEST] on the [MAKER MAINTENANCE] screen, and the following screen is displayed.



2. Select the pattern to be printed using the right/left key.

Pattern	Process
	Prints dot pattern.
	Prints rectangular waveforms in the format shown by Fig.3.
	Prints diagonal lines in the format shown by Fig. 4.

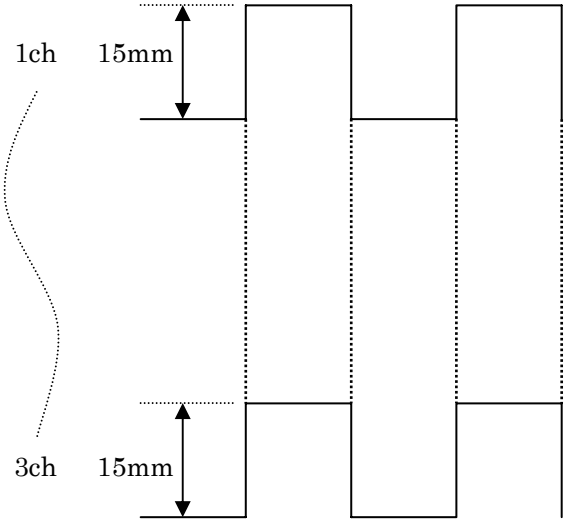


Fig. 3

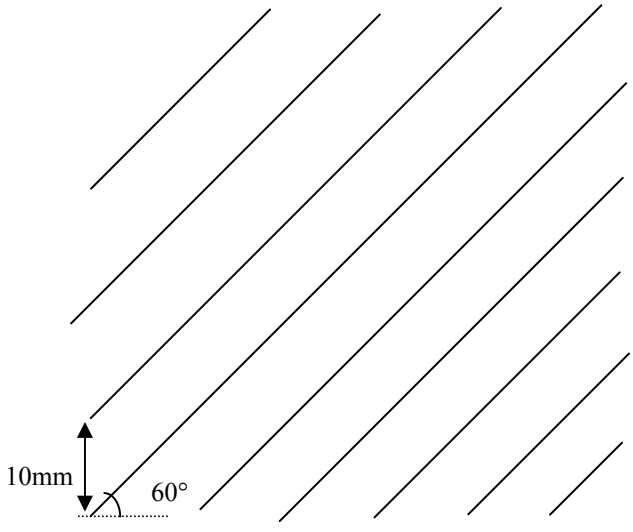
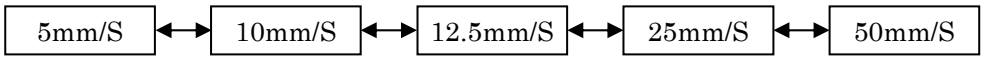


Fig. 4

3. Push the [START/STOP] key to start a recorder test. Select transfer speed using the right/left key while printing is underway.

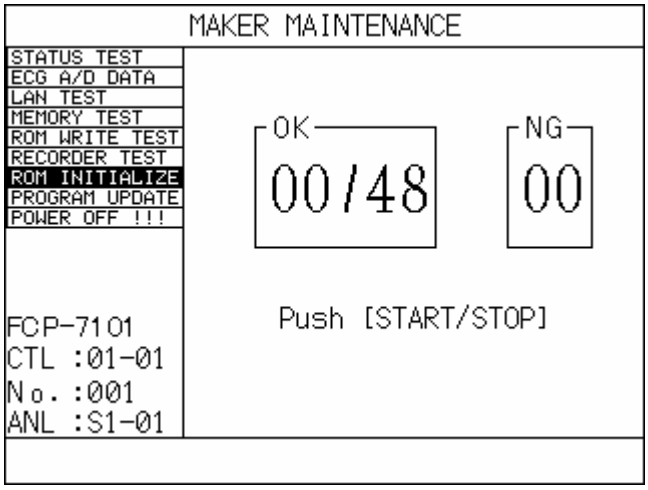


4. Push the [START/STOP] key once again to terminate the recorder test.

Memory Initialize

The embedded memory can be initialized following the procedure shown below.

1. Select [ROM INITIALIZE] on the [MAKER MAINTENANCE] screen, and the following screen is displayed.



2. Push the [START/STOP] key to start initializing the embedded memory.

3. On completion of initialization of the embedded memory, “Rom memory initialization completed” message appears.

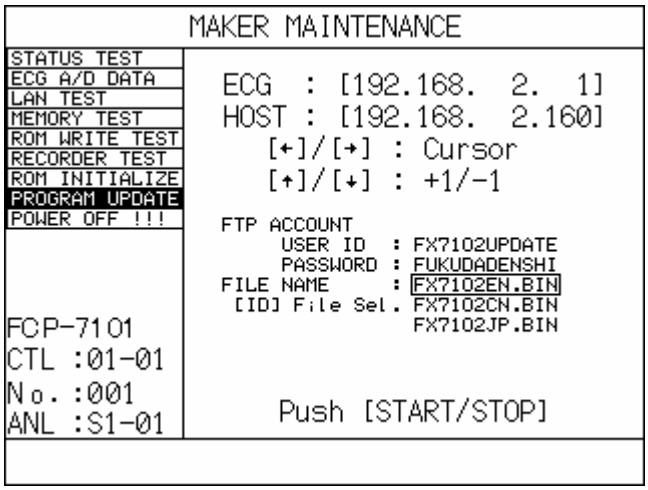
Note

Once the embedded memory is initialized, the data cannot be restored.

Update

The software installed in the ECG can be updated following the procedure shown below.

1. Select [PROGRAM UPDATE] on the [MAKER MAINTENANCE] screen, and the following screen is displayed.



2. Enter the IP address of the ECG and that of the HOST, using the [←], [→], [↑], or the [↓] key.

3. Press the [ENTER] key, and then select software with the [ID] key according to the destination by referring to the following table.

Name of software file to be updated	Destination
"FX7102EN.BIN"	General export
"FX7102CN.BIN"	China
"FX7102JP.BIN"	Within Japan

4. Connect the LAN cable to the LAN port and push the [START/STOP] key, and the UPDATE is started.

Note To update the software, the environment where LAN can be connected is required.

Note On completion of updating, the ECG is automatically reset.

Periodical inspections

To maintain the unit's functions and performance, periodical inspections are required.
The inspections explained in this section should be performed by service representatives who have sufficient technical knowledge.

●Periodical inspection intervals and precautions

Inspection item	Description
Periodical inspection interval	Periodical inspection should be performed at least once a year.
Precautions before inspection	Simplified circuits that are used to measure protective earth resistance are illustrated; however, fire, electric shock, and other hazards accompany the manufacture and use of such circuits. Handle with care.
Precautions after inspection	After the inspection is completed, clean each part.
Measuring device used for inspection	Electronic voltmeter or digital voltmeter

●List of periodical inspection items

Inspection item	Description
Safety inspection	Enclosure leakage current inspection Patient leakage current I inspection Patient leakage current III inspection Patient measurement current inspection
Inspection of electrical performance/ characteristics	Sensitivity Time constant (AMP) Frequency characteristic Control of in-phase signal Counter electrode voltage Internal noise Recording sensitivity
Hardware inspection	Patient cable/connecting cable inspection Limb electrode/chest electrode inspection Recording paper/Keratin cream inspection Operation Manual inspection Trolley/cord hanger inspection (if any) Enclosure inspection Rating label inspection Switch inspection Power supply fuse inspection Recorder inspection Electrode inspection

●Safety inspections (4 items)

To assure safety of medical equipment, testing methods and measurement equipment are prescribed in the safety test standards with respect to leakage current that affects human body. To perform inspections, make the setting and pass/fail evaluation using a leakage current gauge that meets the requirements for measurement of medical equipment.

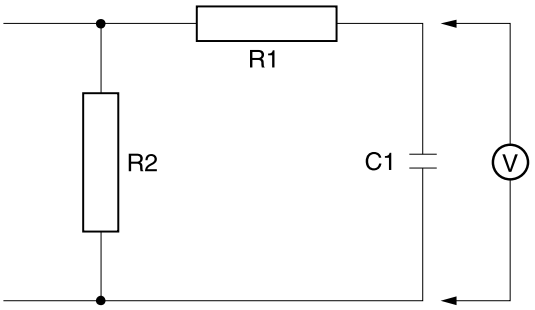
⚠WARNING

If, during a safety inspection, a value that exceeds the allowable limit is detected, immediately stop using the unit and replace the defective part or make proper repairs. Otherwise a serious accident may result.

Before checking the leakage current

There are a number of conditions for measuring leakage current. Adopt the maximum value obtained as measurement value.
It is also very important to compare the obtained value with past measurement values to confirm that no significant difference is observed.

To measure the leakage current, use a leakage current gauge provided with human body simulation impedance (network) as shown below.



R1 : 10k Ω ± 5% (No lead)
R2 : 1k Ω ± 1% (No lead)
C1 : 0.015μF ± 5% (No lead)
V : Voltmeter

Measure the voltage at both ends of the human body simulation impedance, and substitute the obtained value into the following formula to obtain current value.

$$\frac{\text{Measured voltage (V)}}{1000} = \text{Measured current (mA)}$$

About leakage current gauge
Since leakage current has significant effect on human body, testing methods, performance of measuring instrument, value limit of leakage current, etc. are specified by various laws and standards. Use a measuring instrument conforming to "IEC 60601-1," which is standard specification of electrical appliances for medical application, to measure the leakage current of this instrument.

Checking the enclosure leakage current (current that flows from the enclosure to the earth terminal of the power outlet)

Measurement condition of the enclosure leakage current
It is required to measure the enclosure leakage current under two conditions: normal condition and single fault condition.

Judgment criteria

Normal state	0.1 mA or lower
Single fault condition	0.5 mA or lower

Checking the patient leakage current I

Measurement condition of the patient leakage current
It is required to measure the patient leakage current in two conditions: normal condition and single fault condition.

Judgment criteria

Normal state	0.01 mA or lower
Single fault condition	0.05 mA or lower

Checking the patient leakage current III

Measurement condition of the patient leakage current
Since the patient leakage current is measured with polarity of the power supply in single fault condition changed, measurement must be made twice to obtain the values under all conditions.

Judgment criterion

Single fault condition	0.05 mA or lower

Checking the patient measurement current

Measurement condition of the patient measurement current
It is required to measure the patient measurement current in two conditions: normal condition and single fault condition.

Judgment criteria

Normal condition	0.01 mA or lower
Single fault condition	0.05 mA or lower

●Inspection of electrical performance/characteristics

1.Sensitivity

(1) Check that the recorded amplitude is within 10±0.2 mm after 1 mV of voltage is added to the unit by the standard voltage generator.

(2) Change the sensitivity selector switch to 1/2, 1/4, and 2, and check that standard sensitivity is within ±5%.

2.Time constant

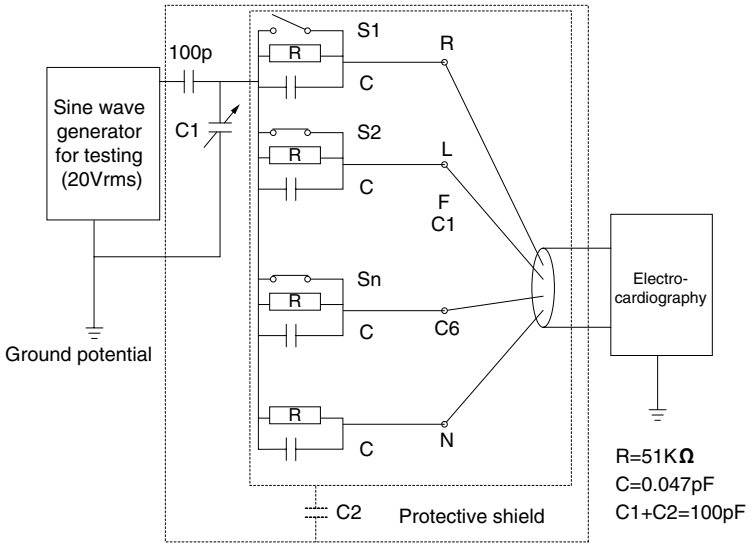
Apply 1 mV of standard voltage and check that it takes from 3.2 to 3.84 seconds for the amplitude (of the wave 3.2 seconds after dropping exponentially) to reach 37% of the amplitude obtained after the standard voltage is added (after 0.04 seconds).

3.Frequency characteristics

Using a sine wave generator, add sine wave voltage to the input of the Electrocardiograph via 27 kΩ of resistance.
Equating 100% to a 10-mm amplitude at 10 Hz for the test voltage, check that 0.14 Hz to 75 Hz is at least 90%, 150 Hz is at least 70%, and 0.05 Hz to 150 Hz is within the range of 70% to 105%.

4. Common mode rejection

In the measurement circuit shown below, set the sensitivity to 2, open S1, and close the other switches; then, while switching the lead, record the fluctuation. Repeat this until Sn, measure the maximum fluctuation, and check that the fluctuation on the recording paper is 4.0 mmp-p or less.



5.Counter electrode voltage

(1) Check that the change in the recorded sensitivity is within ±5% when ±550 mV of DC voltage is imposed to the input of the Electrocardiograph.

(2) Check that the change in the recorded sensitivity is within ±5% when ±550 mV of DC voltage is imposed between the two input terminals of the Electrocardiograph and the RF(N) electrode fitting.

6.Internal noise

Make shortcircuited the each terminal of all input terminals with the parallel impedance with 51kΩ and 47nF. Place the baseline at the center at each lead selection position, set the sensitivity to 2, and record the noise. Check that the size of the noise on the recorded line is 0.4 mmp-p or smaller at random 0.2-second intervals.

7.Recording speed

Connect a clock that provides the unit with signal voltage at 1-second intervals, and record the pulse waveform. Check that the error in transfer speed at speeds of 5mm/sec, 10 mm/sec, 12.5mm/sec, 25 mm/sec, and 50 mm/sec is within ±3%.

●Hardware inspections (10 items)

⚠WARNING

If, during a hardware inspection, you notice damage or other abnormality, immediately stop using the given unit; then replace the defective part, replenish, or make proper repairs.
Failure to repair the unit can lead to a serious accident.
Do not replace the part nor carry out refilling or the like but change the hardware (MAIN BOARD, for ex.) found faulty. If the trouble cannot be remedied by replacing any part, for example, the guarantee clause of the supplier will nopushply to the relevant hardware.

Checking the patient cable/connecting cable

Description
Check the patient cable/connecting cable for open circuit, the covered area for damage, and the connector pins for interference/rust/contamination.

Checking the limb electrode/chest electrode

Description
Check for adherence of dust and rust.

Checking the recording paper/Keratin cream

Description
Check that they are set correctly.

Checking the operation manual

Description
Check that it is stored in the correct place without any damage.

Checking the trolley/cord hanger (if any)

Description
Check that trolley body's installation status, trolley's exterior, casters' status, and cord hanger's exterior, and also check the mounting screws for looseness.

Checking the enclosure

Description
Check the enclosure of the unit for flaws, cracks, deformation, rust, and other exterior defects.

Checking the rating label

Description
Check the rating label for separation, cleanliness, legibility, and other exterior defects.

Checking the switches

Description
Check for unsmooth operation, damage, and rattling.

Checking the recorder

Description
Check that recording operation is smoothly performed and no abnormal noise exists.

Checking the electrodes

Description
Check the electrodes for corrosion, and their chip-mounting area for wear, safety defects, malfunctional operation, and damage.

Periodical inspection(2) record

Item		Description	Procedure/measurement value Acceptance standard	Judge-ment	Remarks (Repair required
Visual inspection	Cables Electrodes Consumables Accessories	1. Power supply cord, patient cable, etc.	Any flaws or damages?	OK・NG	
		2. Limb electrode, chest electrode, etc.	Any contamination or rust adhered?	OK・NG	
		3. Recording paper/Keratin cream	Correctly set?	OK・NG	
		4. Operation Manual	Stored in a correct place?	OK・NG	
		5. Trolley/cord hanger, etc.	Any damages?	OK・NG	
	Appearance	1. Flaws/cracks/deformation/rust on enclosure	Any damages?	OK・NG	
		2. Peel-off or dirt on rating label or panel	Display visible?	OK・NG	
		3. Key	Any damages?	OK・NG	
Mechanical	Main unit	1. Key	Smoothly move?	OK・NG	
		2. Recorder	Smoothly move? Any abnormal noise?	OK・NG	
	Accessories	1. Power supply cord, patient cable	Any rattling?	OK・NG	
		2. Electrodes	Any problem in connection?	OK・NG	
Manufacturer self-diagnostics	Performance	1. Status	Are thermal head temperature, lithium battery voltage, mark sensor status, and recording paper detection operation normal in the status test?	OK・NG	
		2. LAN	Is LAN communication normal?	OK・NG	
		3. Memory	Any abnormality on pass and error counts?	OK・NG	
		4. ROM	Is write to ROM normal?	OK・NG	
		5. Recorder adjustment	Is the location of thermal print head correct when recorder is moved?	OK・NG	
		6. Power OFF	Does pressing of the ENTER key normally turn off the power?	OK・NG	
Cleaning and disinfection		1. Cleaning, disinfection, pasteurization, and sterilization		OK・NG	

Item	Description		(Acceptance standard) Measurement value	Judgement	Remarks (Repair required
	1. Enclosure leakage current	Normal condition	(0.1m or less) mA	OK・NG	
		Single fault condition	(0.5mA or less) mA	OK・NG	
	2. Patient leakage current I	Normal condition	(0.01mA or less) mA	OK・NG	
		Single fault condition	(0.05mA or less) mA	OK・NG	
	3. Patient leakage current III				
		Single fault condition	(0.05mA or less) mA	OK・NG	
	4. Patient measurement current (AC)	Normal condition	(0.01mA or less) mA	OK・NG	
		Single fault condition	(0.05mA or less) mA	OK・NG	
Electric performance/characteristics inspection	1. Sensitivity	(Standard sensitivity) ×1	(10±0.2 mm or less) mm	OK・NG	
		×1/2	(5 mm±5% or less) mm	OK・NG	
		×1/4	(2.5 mm±5% or less) mm	OK・NG	
		×2	(20 mm±5% or less) mm	OK・NG	
	2. Time constant	37%	(3.2 to 3.84 sec.) sec	OK・NG	
	3. Frequency characteristics	10Hz・10mm amplitude 100% 0.14Hz	(90% or more) %	OK・NG	
		75Hz	(90% or more) %	OK・NG	
		150Hz	(70% or more) %	OK・NG	
		All bonds	(105% or less) %	OK・NG	
	4. Common mode rejection	60 Hz, 20 V, RMS sine wave, sensitivity 2	(4 mm P-P or less at sensitivity 2) mm	OK・NG	
	5. Counter electrode voltage	±550 mV imposed DC voltage	(10 mm±5% or less) %	OK・NG	
	6. Internal noise	27kΩ input short, sensitivity 2	(0.4 mm P-P or less at sensitivity 2 (Noise : 20 μV or less)) mm	OK・NG	
	7. Recording speed	5 mm/s	(±3% or less) %	OK・NG	
		10 mm/s	(±3% or less) %	OK・NG	
		12.5 mm/s	(±3% or less) %	OK・NG	
		25 mm/s	(±3% or less) %	OK・NG	
		50 mm/s	(±3% or less) %	OK・NG	
Overall judgement				OK・NG	

Machine type		Model		Serial No.	
Location installed			Date purchased		
Date inspected		Inspector		Approval	

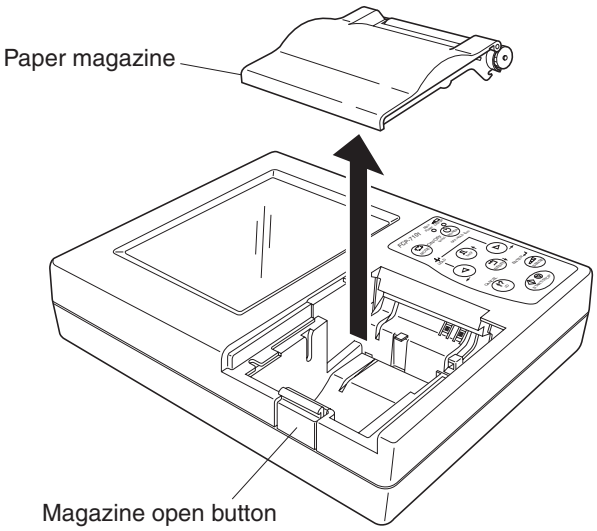
Chapter 4

Disassembly

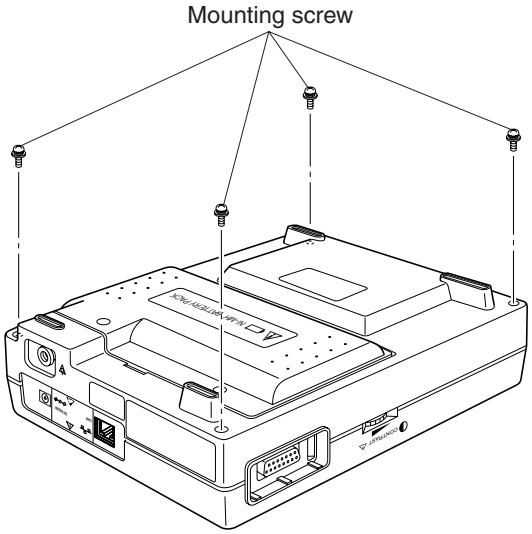
Removing the LCD 4-1
Removing the enclosure cover 4-2
Removing the recorder unit 4-3
Removing the main board 4-4

Removing the LCD

1. Press the magazine open button and remove the paper magazine.



2. Remove the mounting screws (four).

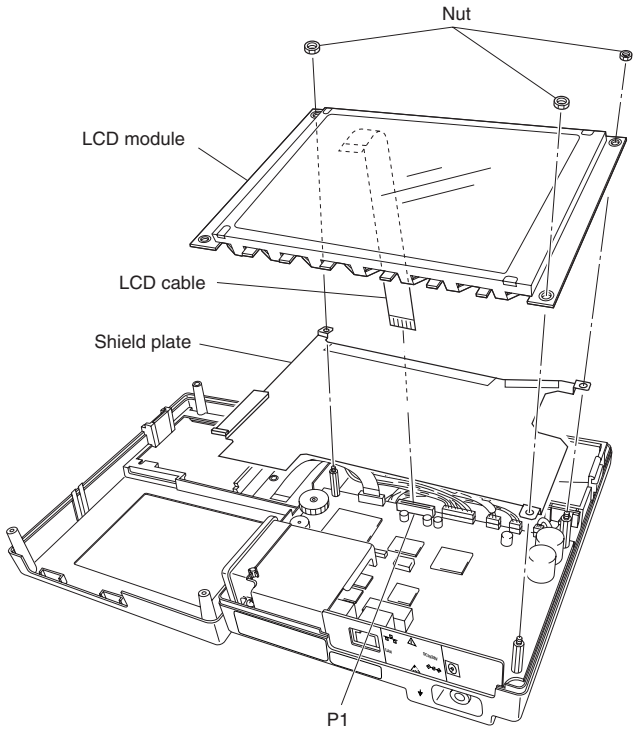


3. Open the top cover.

4. Remove the nuts (three) fastening the LCD.

5. Lift the LCD and remove the shield plate placed under the LCD.

6. Remove the LCD cable connected to connector P1.

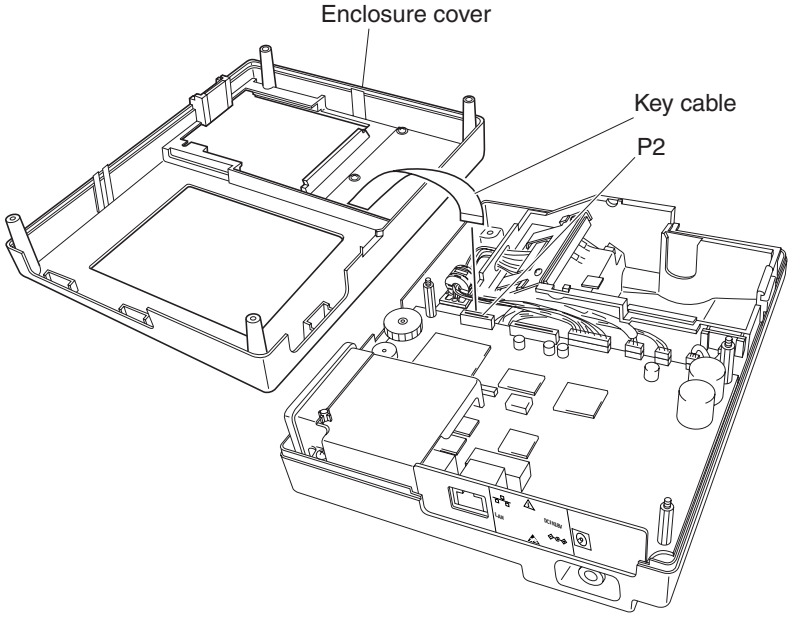


Removing the enclosure cover

1. Remove the LCD

REFERENCE For details on removing procedures, see page4-1, “Removing the LCD”.

2. Remove the KEY cable connected to connector P2.



Removing the Recorder unit

1. Remove the LCD.

REFERENCE For details on removing procedures,see page4-1”Removing the LCD”.

2. Remove the enclosure cover.

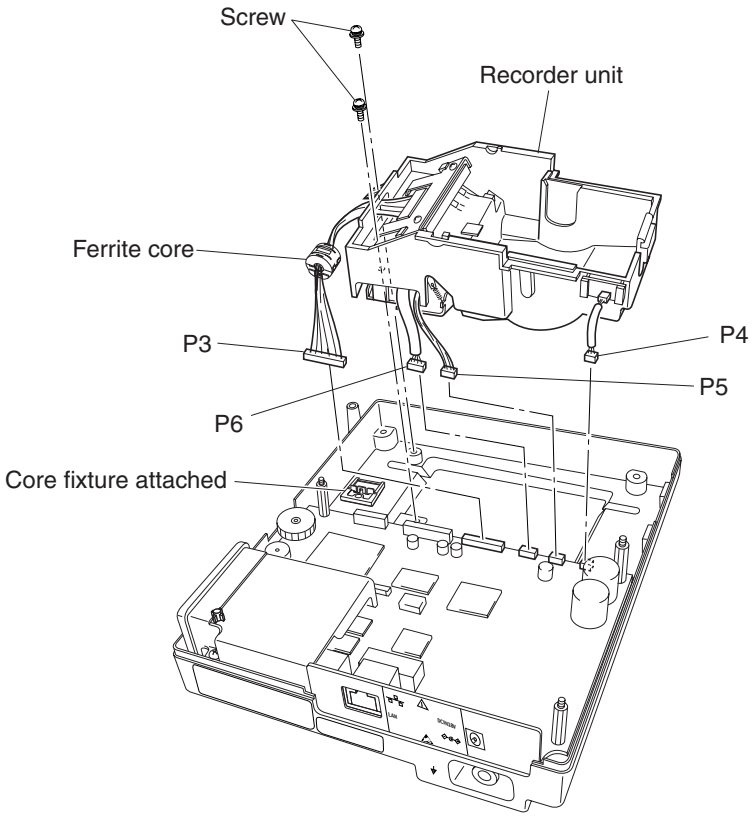
REFERENCE For details on removing procedures, see page4-2”Removing the enclosure cover”.

3. Remove the cables connected to connectors P3, P4, P5 and P6.

4. Remove the ferrite core from the core fixture attached to the lower case.

5. Remove the mounting screws (two) of the recorder unit.

6. Move the recorder unit slightly to the right and remove it.



Removing the main board

⚠CAUTION

To prevent damage by static electricity,eliminate static electricity from your body before touching the board.

1. Remove the LCD

REFERENCE For details on removing procedures,see page 4-1 ”Removing the LCD”.

2. Remove the enclosure cover.

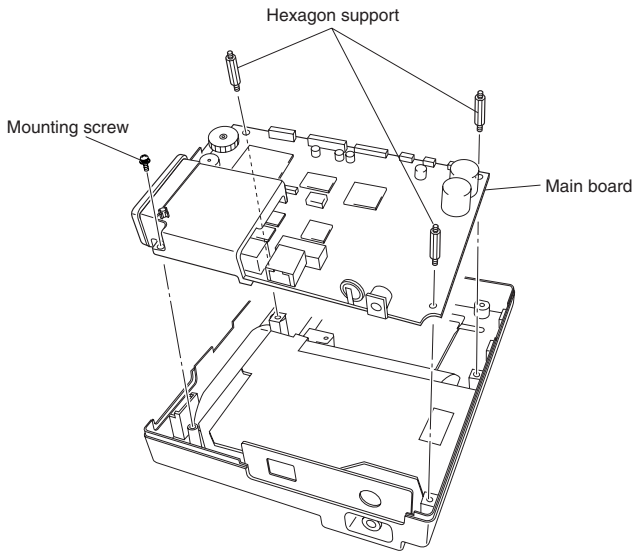
REFERENCE For details on removing procedures, see page 4-2 ”Removing the enclosure cover”.

3. Remove the recorder unit.

REFERENCE For details on removing procedures,see page 4-3 “Removing the recorder unit”.

4. Remove the hexagon support (three) and the mounting screw (one) fastening the MAIN BOARD.

5. Remove the MAIN BOARD.



⚠CAUTION

If the battery is installed, make sure to remove it in advance.

Otherwise the MAIN BOARD cannot be removed.

Chapter 5

Electric Circuit Diagrams

Overall block diagram of unit (AC adaptor not included) 5-1

MAIN BOARD block diagram 5-3

MAIN BOARD (PCB-6950) circuit 5-5

1.Digital logic block 5-5

CPU section 5-5

FPGA section 5-5

Memory section 5-6

KEY I/F section 5-8

Thermal head control section 5-9

Real time clock 5-10

Reset circuit section 5-11

Sensor control section 5-12

Motor control section 5-13

LCD voltage generating section 5-14

2.ECG AMP block 5-15

3.Power supply block 5-16

Power voltage generating section 5-17

Battery charging section 5-20

Power control section 5-21

KEY BOARD (PCB-6949) circuit 5-22

SENSOR BOARD (PCB-6948) circuit 5-23

MAG UP BOARD (PCB-6951) circuit 5-23

AC adaptor block diagram 5-24

MAIN BOARD Circuit Diagrams (PCB-6950) 5-25

Power connection table No.1 5-25

Power connection table No.2 5-26

POWER /CAPACITOR/REST IC/CLOCK

LCD POWER block 5-27

CPU block 5-28

FPGA block 5-29

MEMORY block 5-30

LAN CONTROL block 5-31

LCD I/F / RTC / LED block 5-32

THERMAL I/F block 5-33

SENSOR I/F /MAGAZIN UP SENSOR I/F
MOTOR I/F /JTAG I/F block 5-34
ECG AMP block
(Differential amplification, multiplexer section) 5-35
ECG AMP block (ADC,CPLD and POWER section) 5-36
MAIN POWER SUPPLY +24V block 5-37
CHARGE block 5-38
+5V /+3.3V /+1.8V Power generation block 5-39
POWER STATUS block 5-40
POWER / CHARGE ERROR block 5-41
+3.3VSTB / +1.8V POWER ON RESET block 5-42
BATTERY ON CONTROL / THERMAL POWER
GENERATION BLOCK 5-43
POWER-MAIN I / F block 5-44
POWER ON / OFF CONTROL block 5-45
KEY BOARD (PCB-6949) 5-46
SENSOR BOARD (PCB-6948) 5-47
MAG UP BOARD (PCB-6951) 5-48

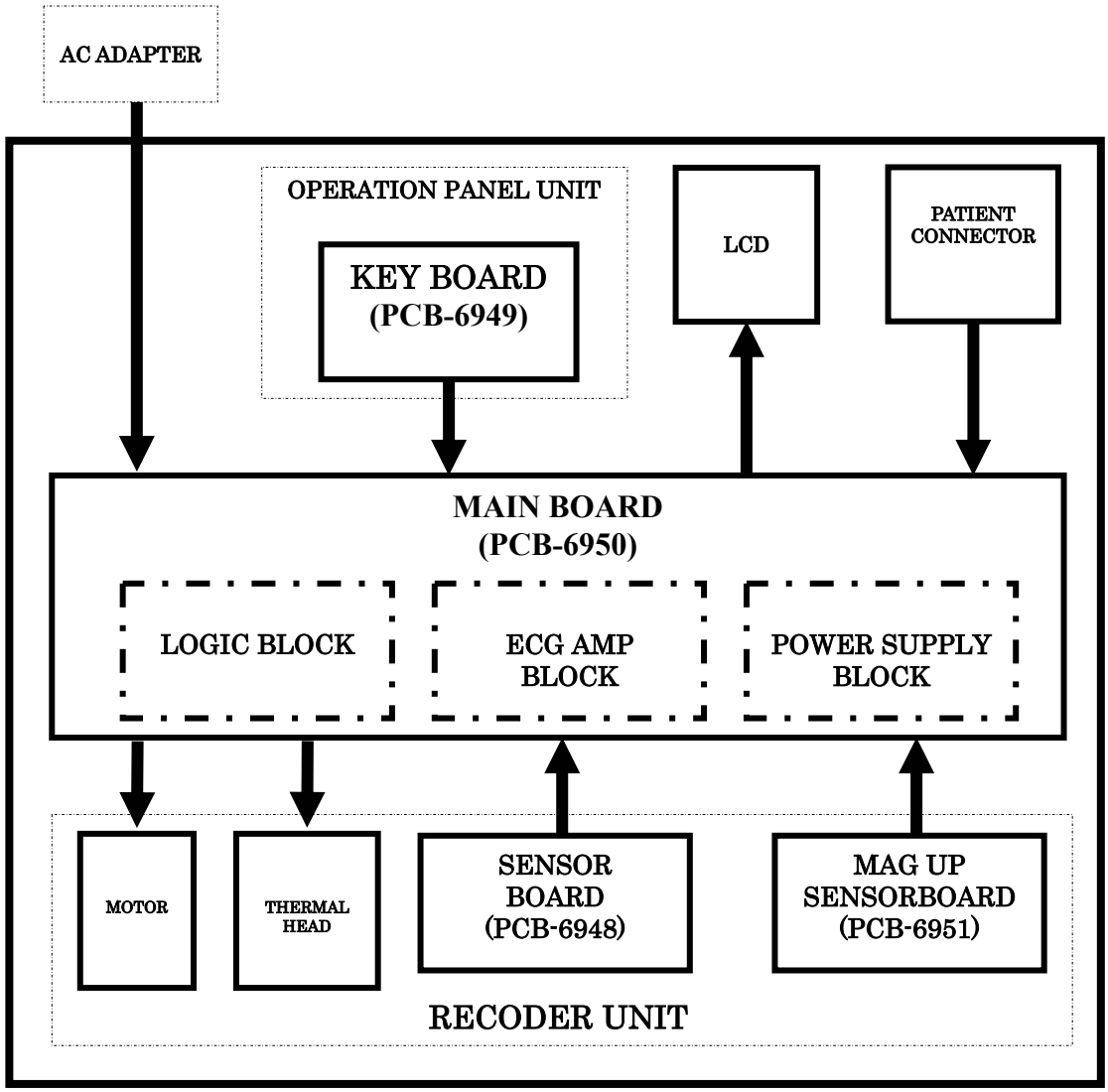
Chapter 5 Electric Circuit Diagrams

Overall block diagram of unit (AC adaptor not included)

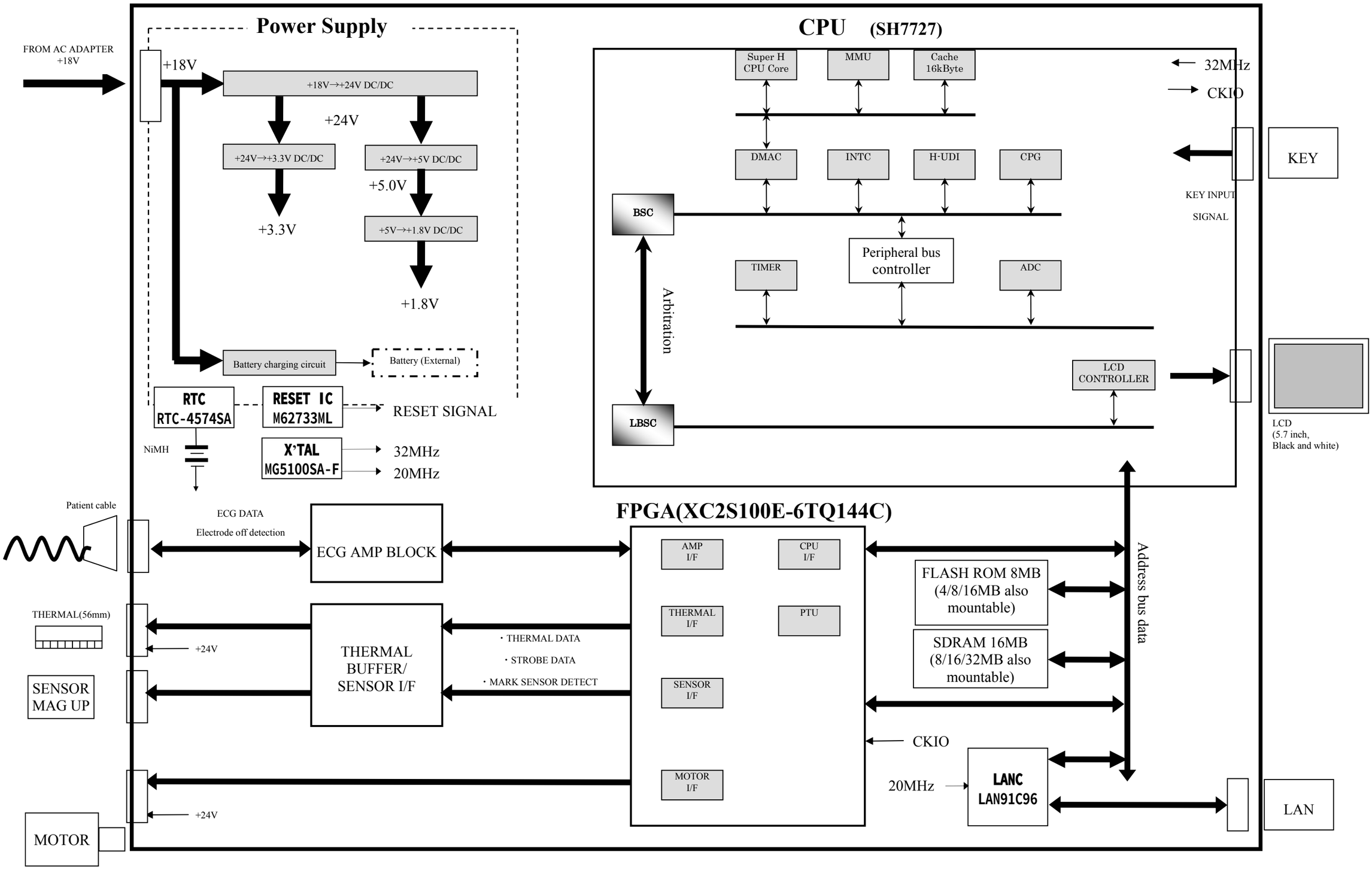
The FCP-7101/FX-7102 is equipped with the following four boards.

1.MAIN BOARD (PCB-6950)
2.KEY BOARD (PCB-6949)
3.SENSOR BOARD (PCB-6948)
4.MAG UP BOARD (PCB-6951)

The MAIN BOARD (PCB-6950) amplifies the ECG signals input from patient connectors at the ECG AMP block, and after AD conversion, performs various processing, measurements and analyses such as ECG display, recording, checking for arrhythmia and R-R intervals.
The KEY BOARD (PCB-6949) is equipped with keys (switches) for operating this instrument. Various operations can be carried out from the key board. It is also equipped with the LED that indicates the operation status of the power supply (AC or DC) and the charging status of the battery.
The SENSOR BOARD (PCB-6948) is equipped with a sensor for detecting the mark position of Z-fold recording paper (OP-122TE, OP-123TE) and a sensor for judging the presence of recording paper.
The MAG UP SENSOR (PCB-6951) is equipped with a switch for detecting the open/close status of the magazine.



●MAIN BOARD block diagram



●MAIN BOARD (PCB-6950) circuit

The main board consists of the following major circuit blocks.
1. Digital logic block
2. ECG AMP block
3. Power supply block

1. Digital logic block

CPU section

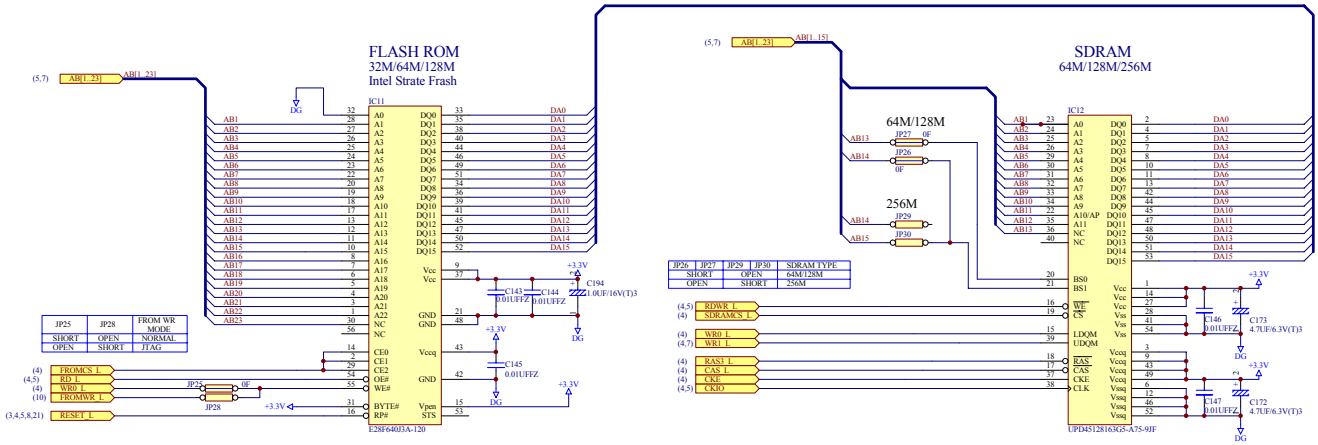
The CPU adopting SH7727 carries out processing for basic operations of ECG such as display of ECG waveforms and recording. It also monitors the voltage of the backup battery and the temperature of the thermal head, and performs processing related to the mark sensor. The CPU carries out various other operations such as address bus control, data bus control, and peripheral device control in accordance with the settings of the software.

FPGA section

The FPGA performs the following control operations.
- ECG control
- Various types of timing control
- Thermal control
- Motor control
- Buzzer control

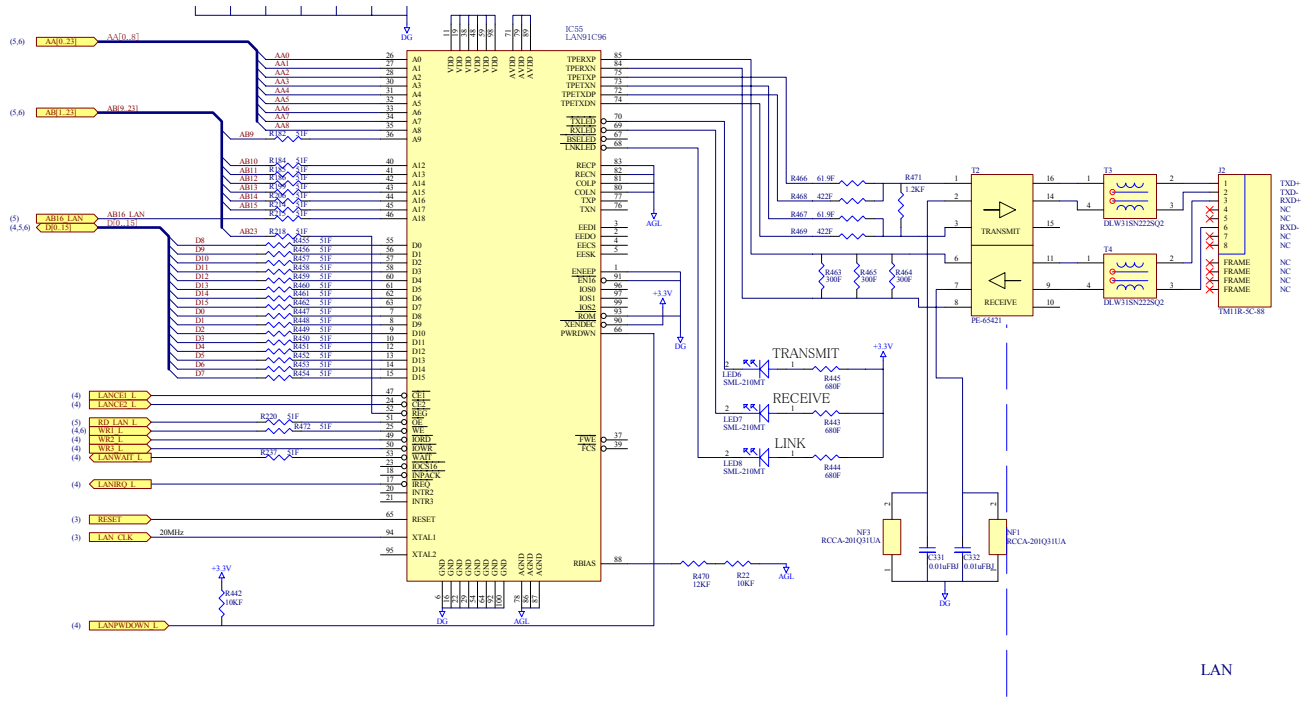
MEMORY section

The memory section uses a flash ROM and a SDRAM.
The flash ROM adopting TE28F640J3A-120 (64Mbits) is used for program storing, function setting storing, and also used as waveform work area.
The SDRAM adopting μPD45128163G5-A75-9JF (128Mbits) is used for program storing and as waveform work area.



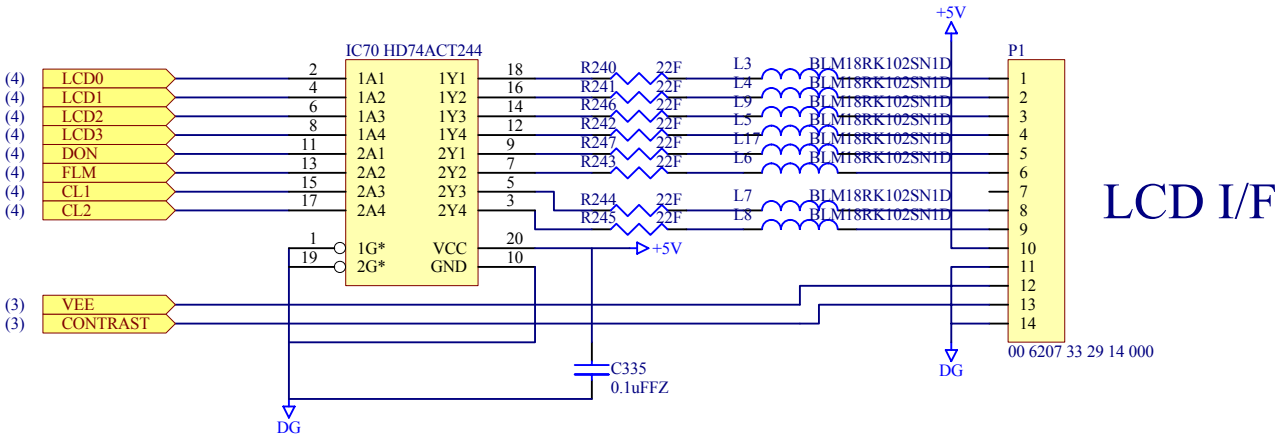
LAN CONTROLLER section

The LAN controller section controls LAN. LAN is used to transmit waveforms recorded with this instrument to outside and when updating the software.



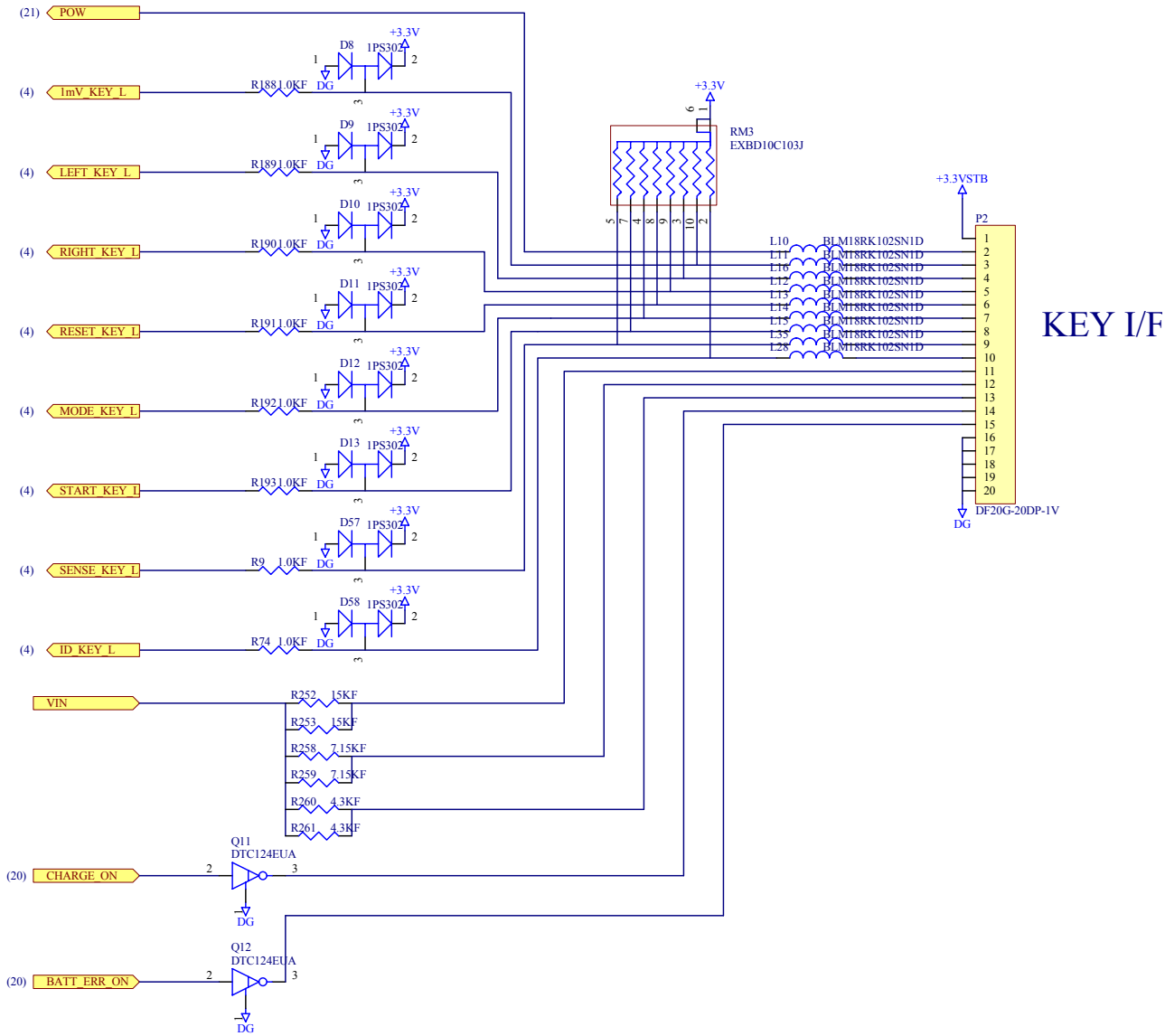
LCD I/F section

The section interfaces with signals to be displayed on the LCD through a buffer.



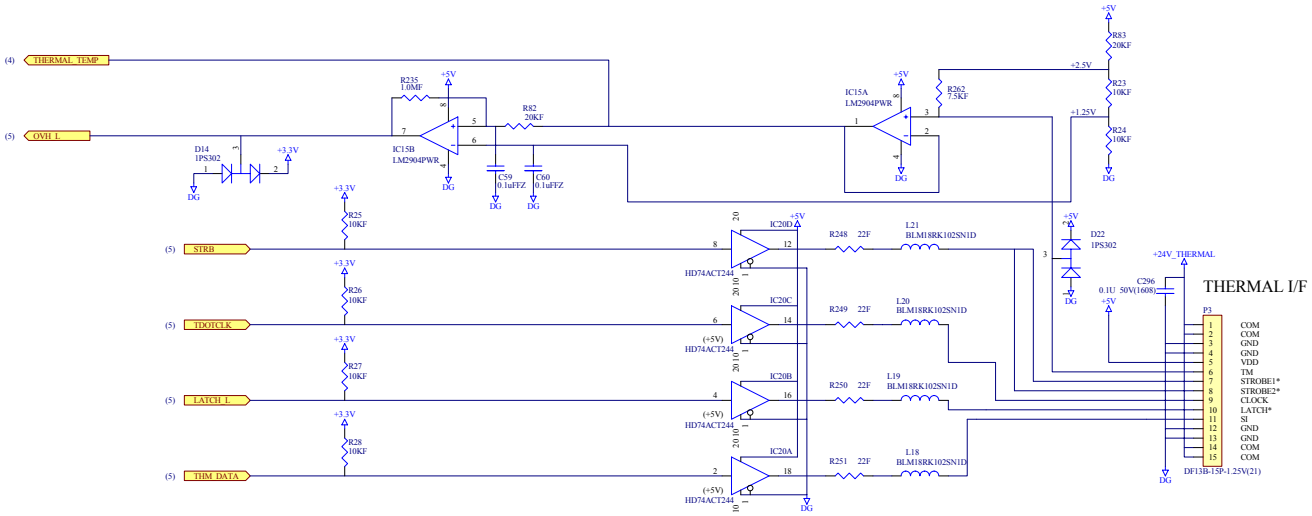
KEY I/F section

The section interfaces with signals input from the keys on the operation panel and buttery control signals.



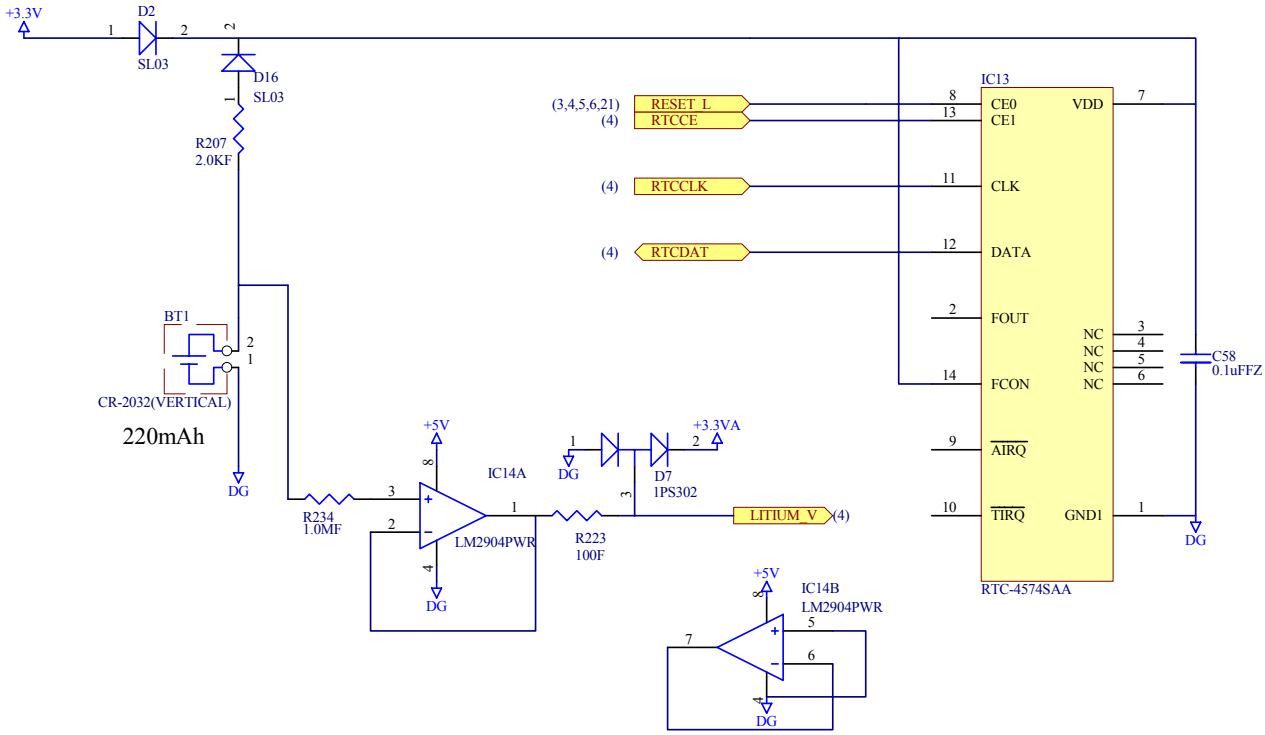
Thermal head control section

The thermal head control section outputs thermal head signals from the FPGA to the thermal head. A buffer for level conversion and R and L are connected as filters to each signal line. The section is also provided with a circuit that generates overheat detection signals to prevent overheating of the thermal head.



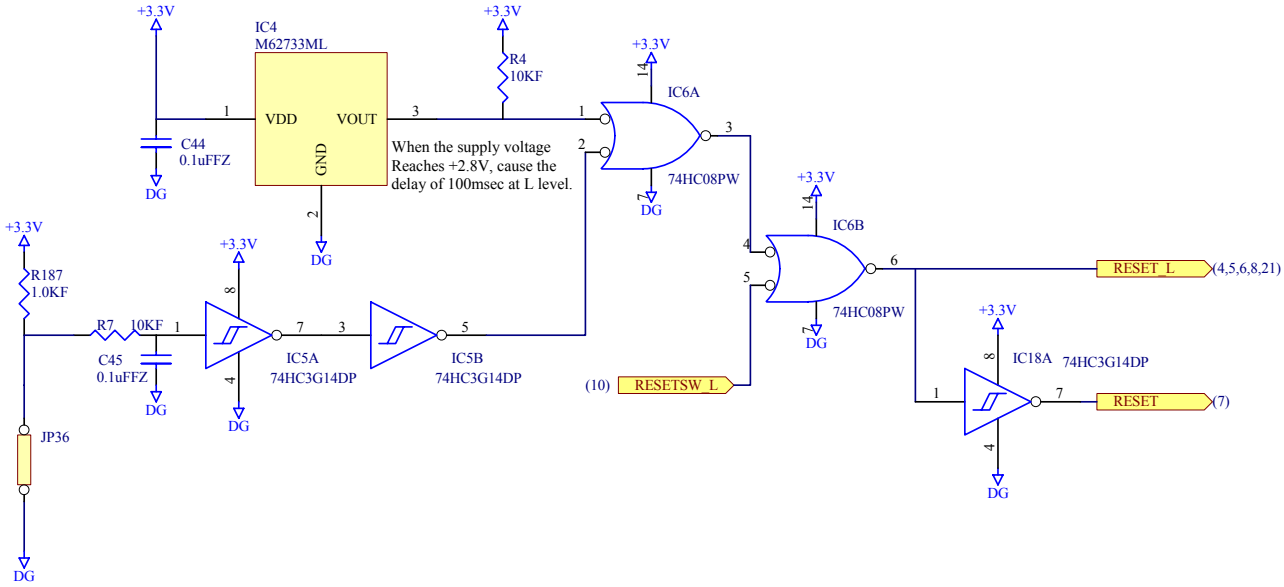
Real time clock

The RTC-4574SAA equipped with a 32.768-kHz crystal oscillator is used as a device for the real time clock. The real time clock operates with a lithium battery (BT1). If a lithium battery is not mounted, the clock does not operate.



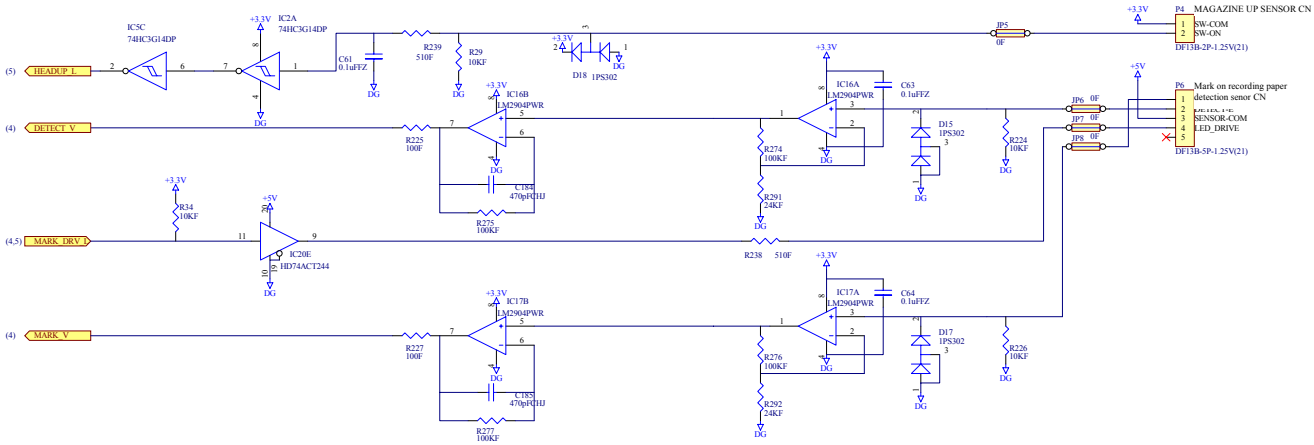
Reset circuit section

The reset circuit section uses M62733ML as a reset IC. The whole system is reset 100msec after the supply voltage reaches +2.87V at the reset IC.



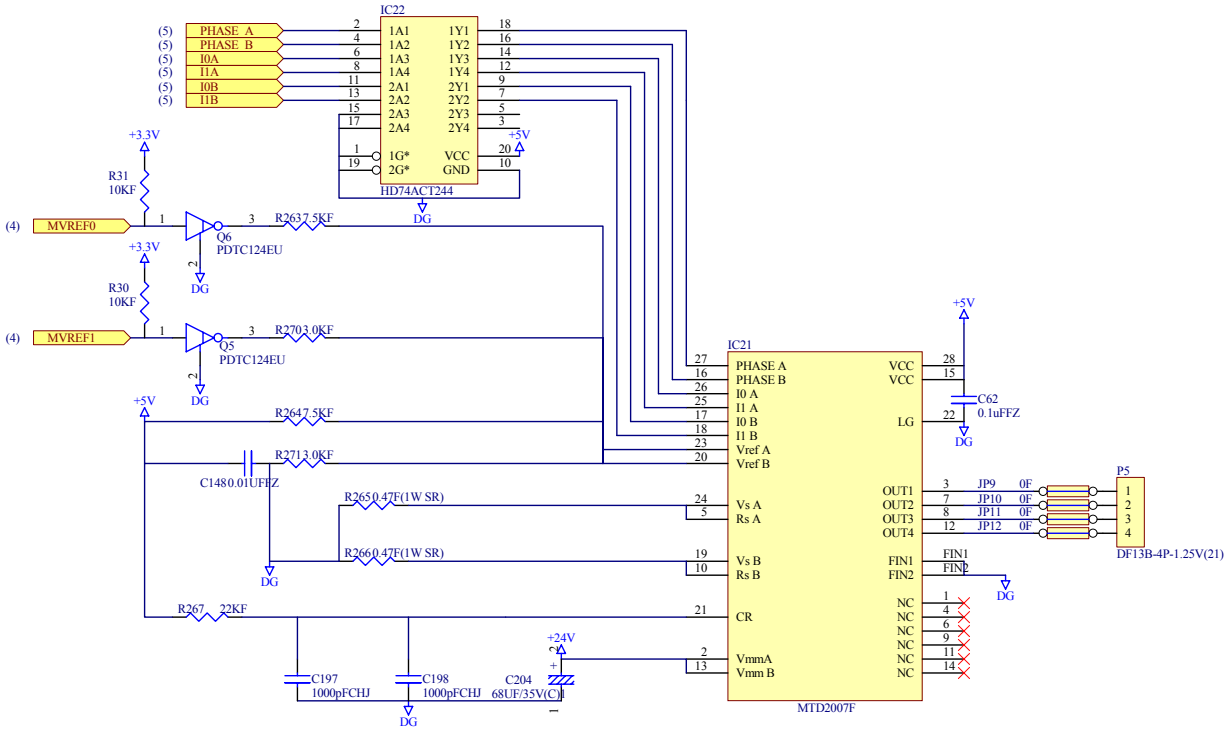
Sensor control section

Two types of sensors are provided, a magazine up sensor and a mark sensor. Signals of the magazine up sensor are output from pin No. 2 of the connector P4. If the magazine opens, the switch is turned off, and an “L” level signal is transmitted to the FPGA. While the magazine is closed, an “H” level signal is output.
Signals of the mark sensor are output from pins Nos. 1 and 2 of the connector 6. Signals for detecting the mark of the recording paper are output from pin No.1, and those for judging the presence of the recording paper are output from pin No. 2. If the mark of the recording paper touches the sensor, or recording paper is not provided, an “L” level signal is output. The signal is then amplified to about 5 times the original signal with μPC358G2 (IC38) and transmitted to the CPU.



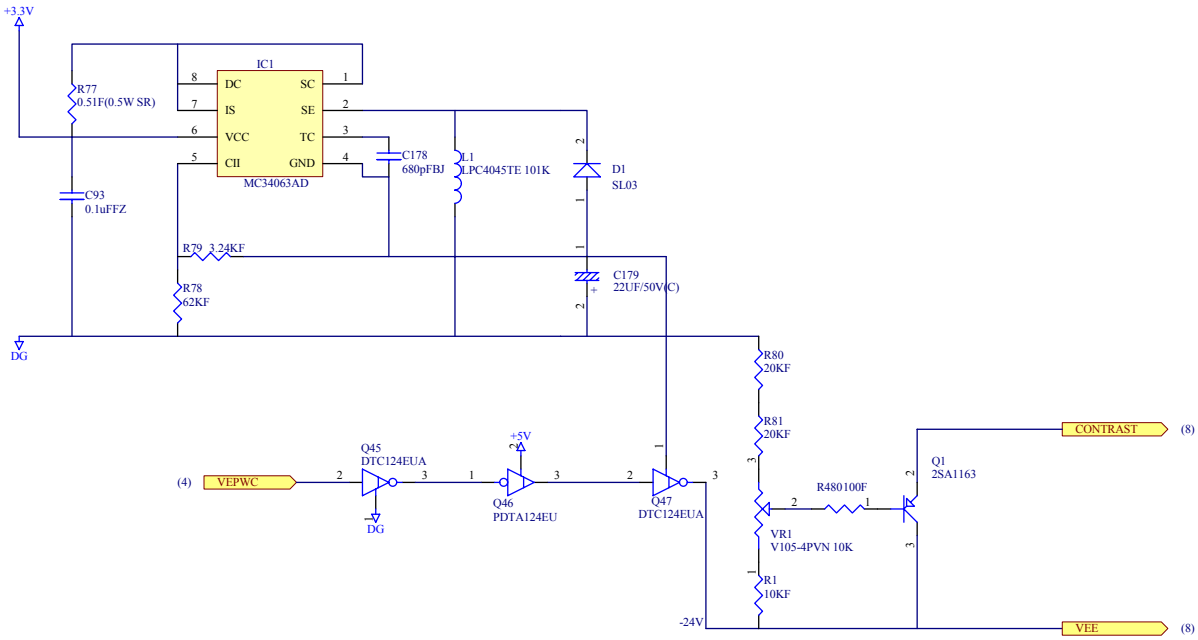
Motor control section

The motor control section is in charge of controlling ON/OFF of the torque of the motor.



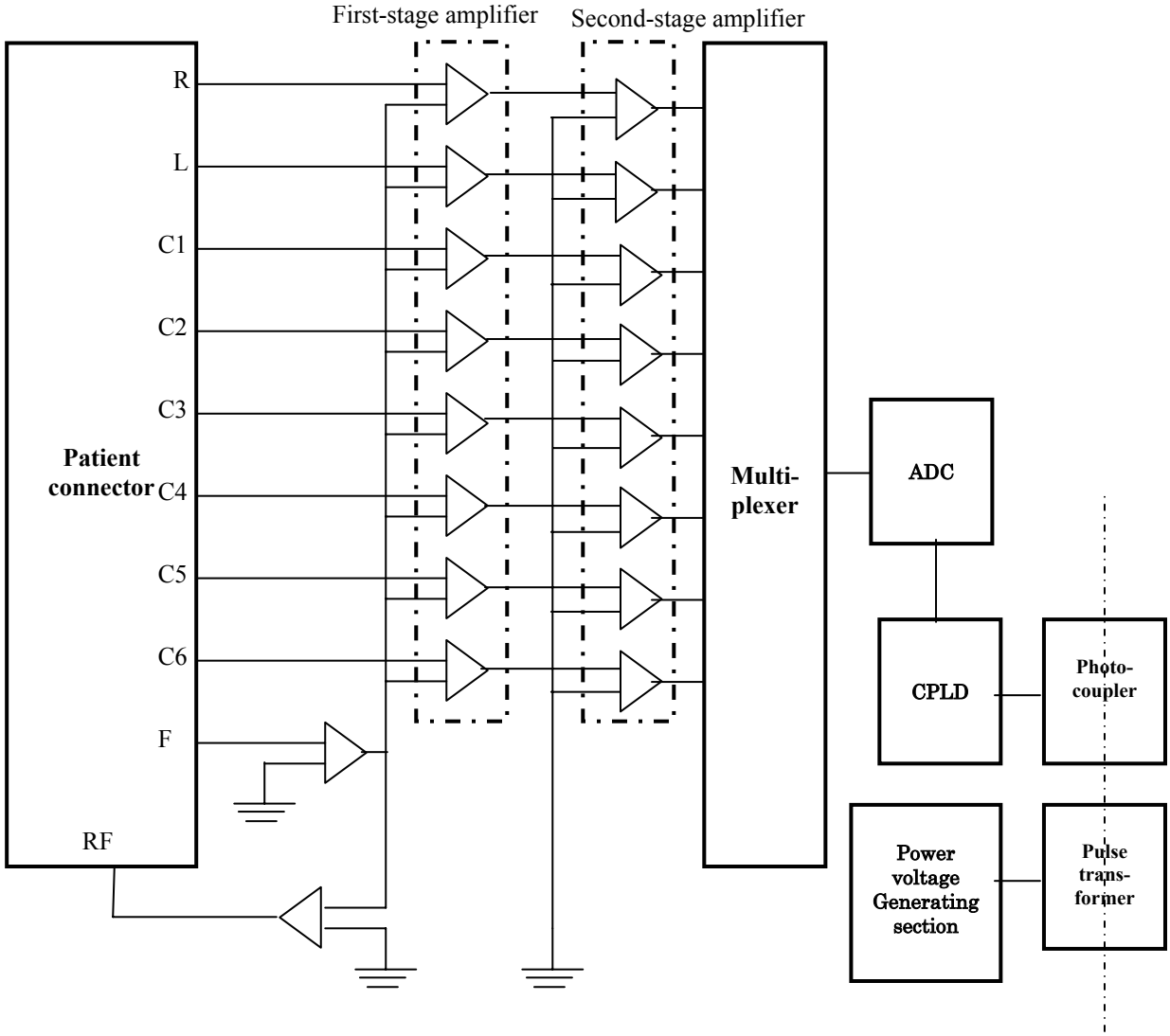
LCD voltage generating section

The section generates LCD voltage (–24V). The use of variable resistor allows the contrast to be adjusted.



2. ECG AMP block

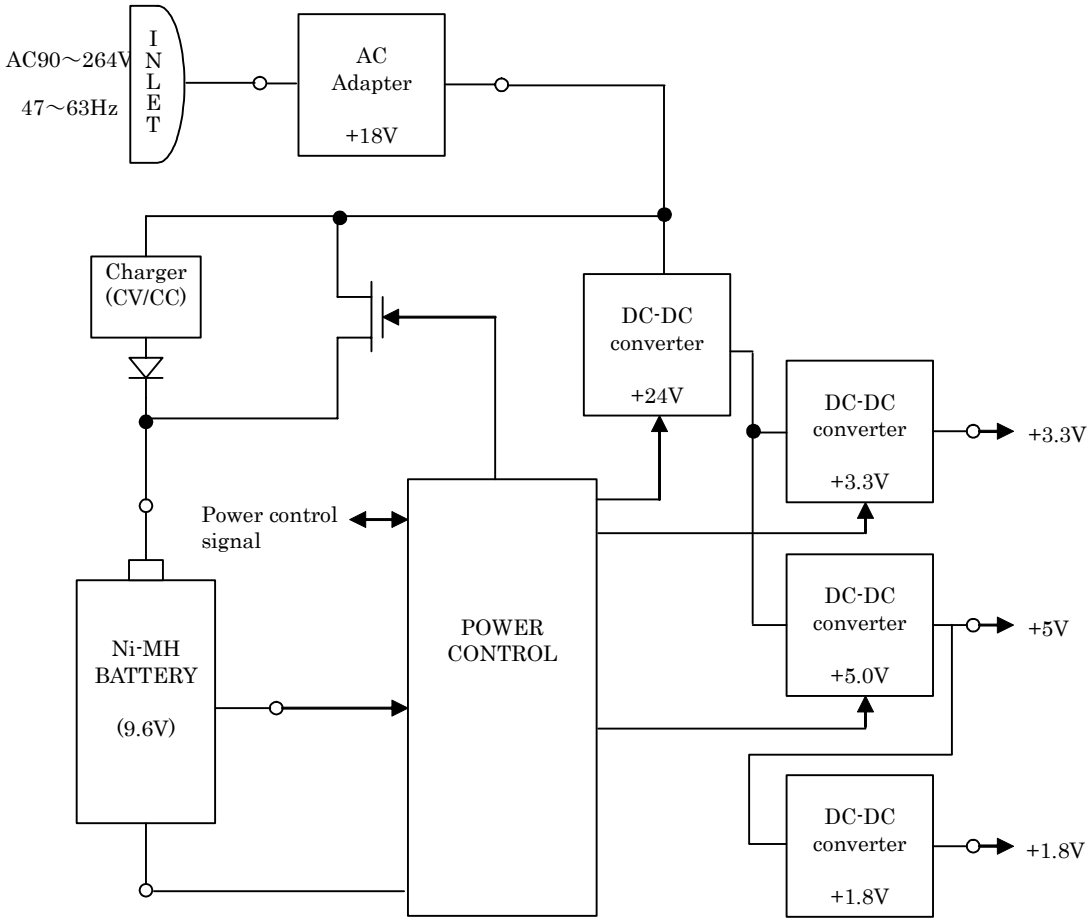
The following is a block diagram of ECG AMP.



ECG signals input from patient connectors go through the input protection section and enter the first-stage amplifier (differential amplifier), where each signal for right arm, left arm, and chest 1 to chest 6 undergoes differential amplification with a signal for left leg.
Each of the output of the first-stage amplifier is input to the second-stage amplifier, signals are then switched sequentially with the multiplexer, and converted to digital signals with the A/D converter.
The digitized ECG signals are then transferred to the CPU with the FPGA.
The ECG AMP block is electrically isolated by a photocoupler and an isolation power supply.

3. Power supply block

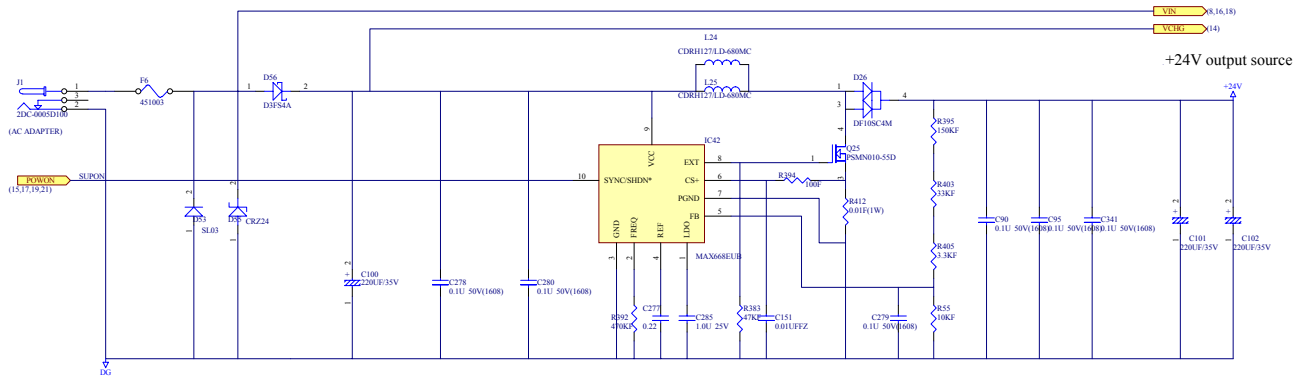
The following is a block diagram of the power supply block.



Power voltage generating section

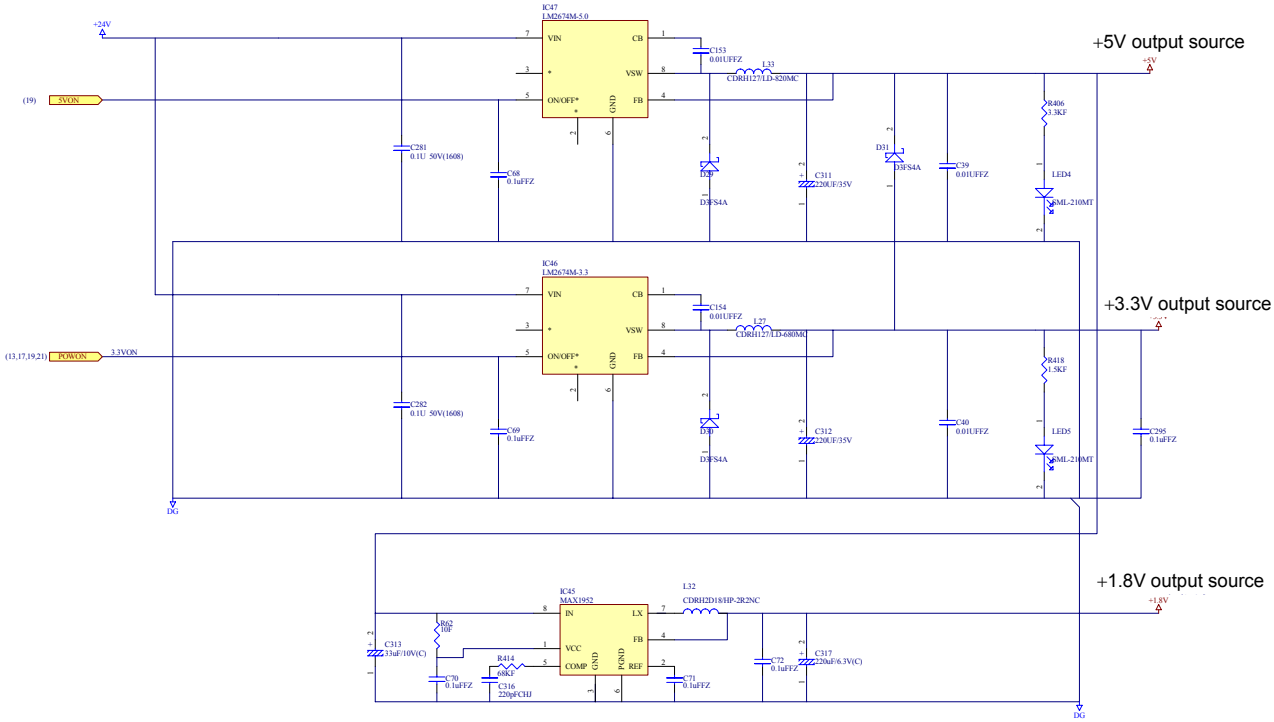
The section generates the following power supply voltages.
(1) +24V
(2) +5V
(3) +3.3V
(4) +1.8V
(5) +3.3VSTB (Standby power supply)
(6) +5V STB (Standby power supply)
(7) +24V (For thermal head)

(1) +24V
The +24V voltage, which is generated from the +18V voltage input from the AC adaptor, is used as the drive voltage of the motor driver.



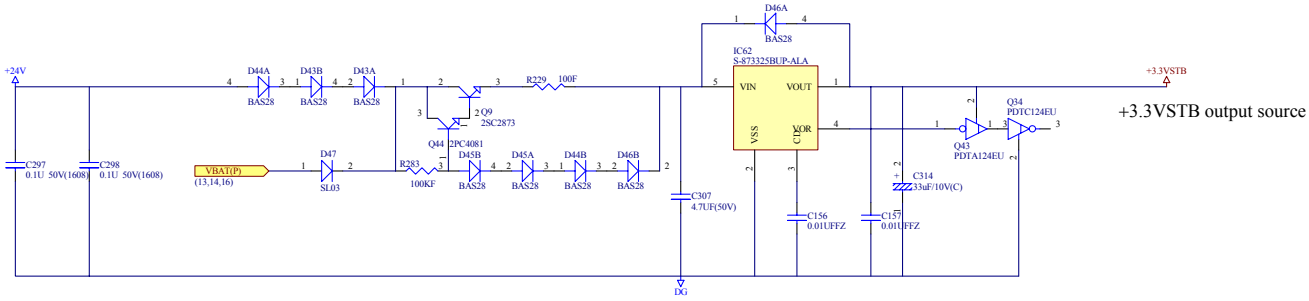
(2) +5V, (3) +3.3V, (4) +1.8V

The +5V and +3.3V voltages are generated from the +24V voltage. The +1.8V voltage, which is generated from the +5V voltage, is used as the core voltage of the CPU and the FPGA.



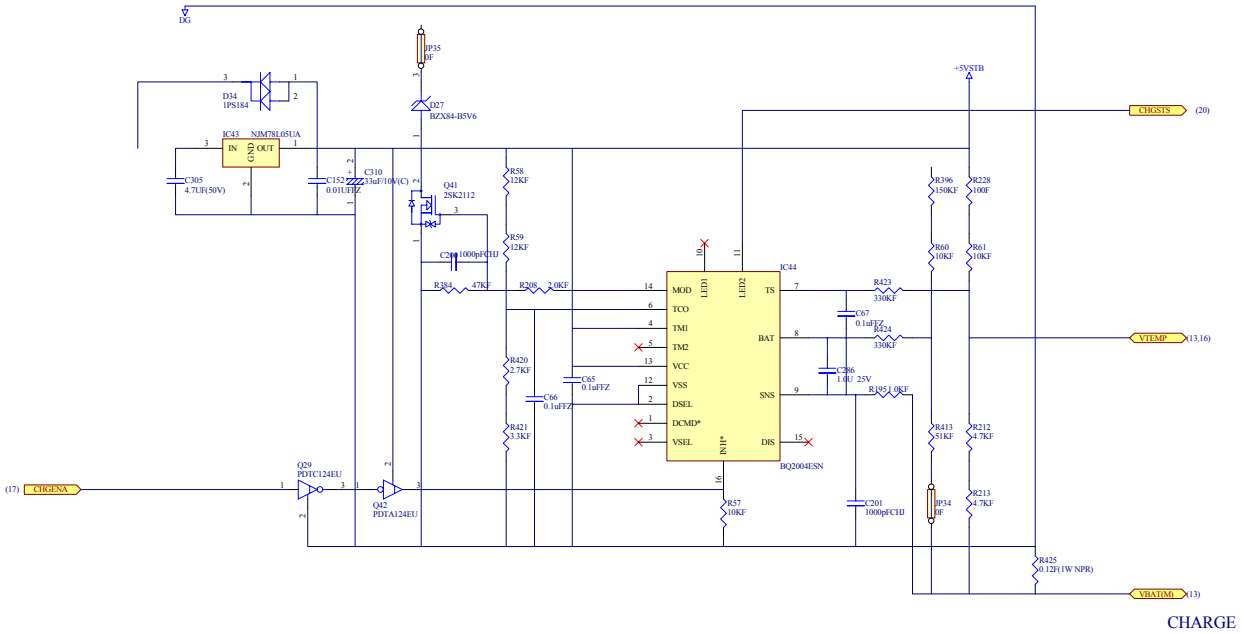
(5) +3.3VSTB (Standby power supply)

The +3.3V standby power supply used when the DC plug or battery is connected is generated from the +24V voltage or the battery pack voltage. The +3.3VSTB is supplied for the IC of the power supply block.



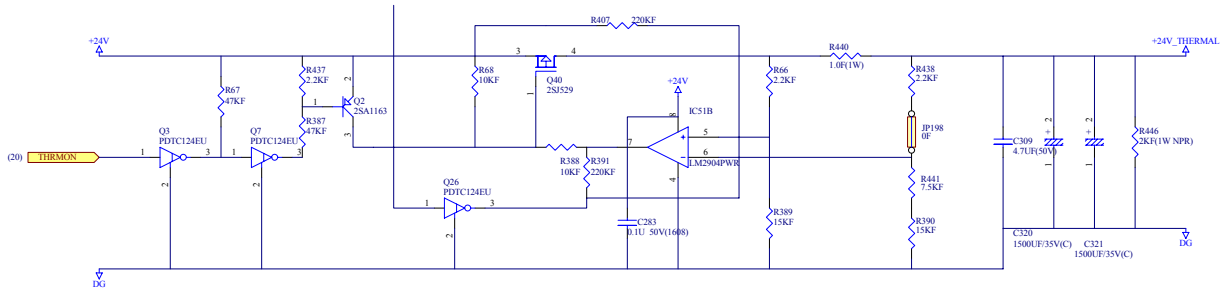
(6) +5V STB (Standby power supply)

The +5V standby power supply used when the DC plug is connected is generated from the +18V voltage. The +5VSTB is supplied for the IC of the power supply block.



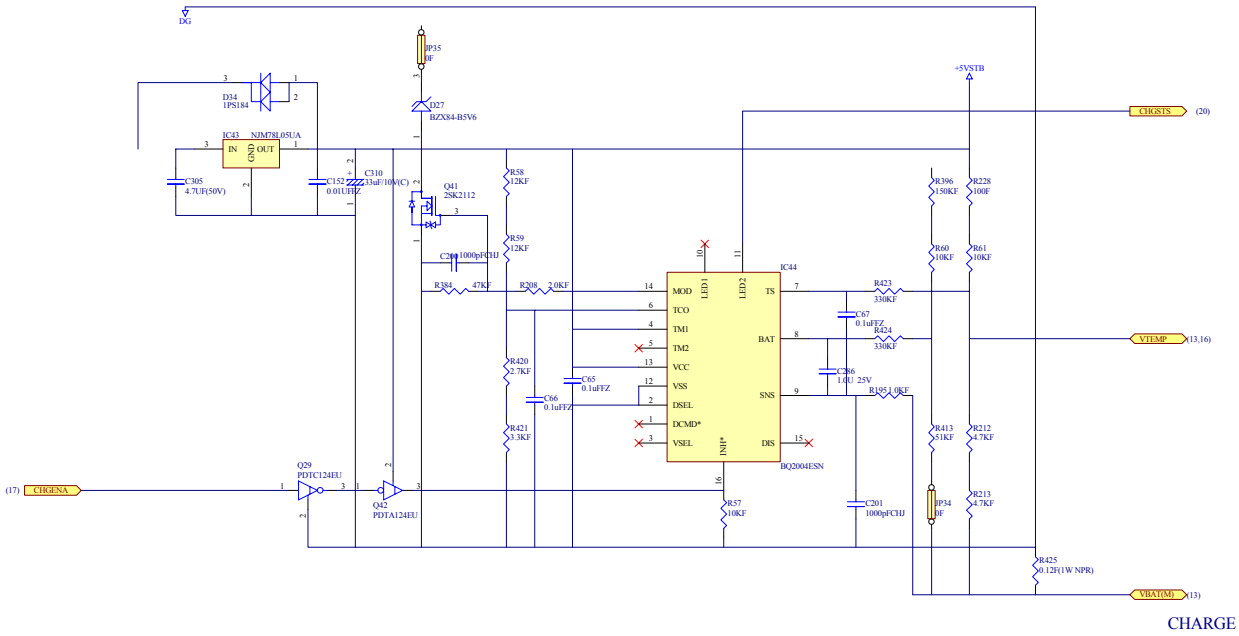
(7) +24V (For thermal head)

The +24V power supply voltage exclusive for the thermal head is generated. A circuit for prevention of overcurrent is provided.



Battery charging section

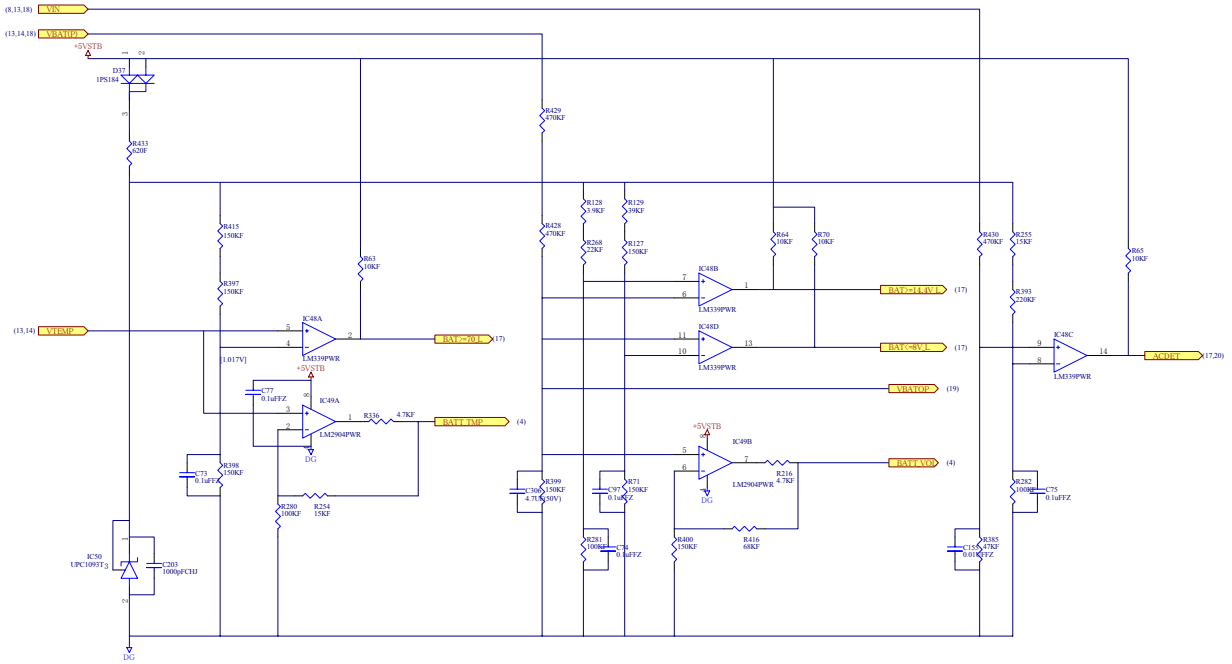
The section charges the battery with a charging IC. It also outputs signals that indicate the battery status (charging underway).



CHARGE

Power control section

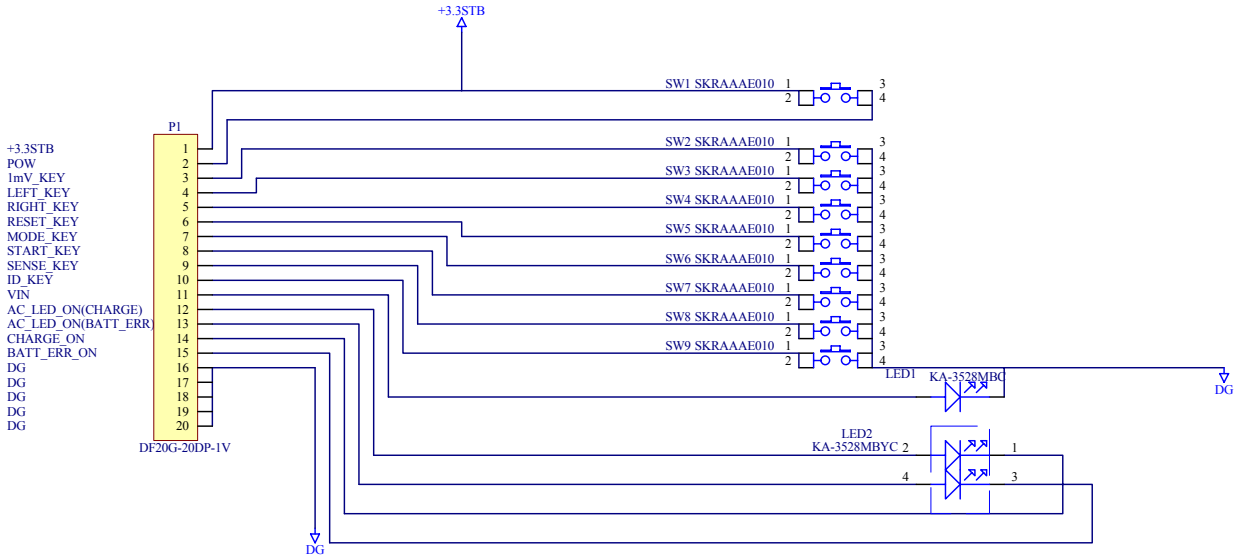
The section monitors the temperature and the voltage of the battery, and transmits the status with various signals.



AC/DC STATUS

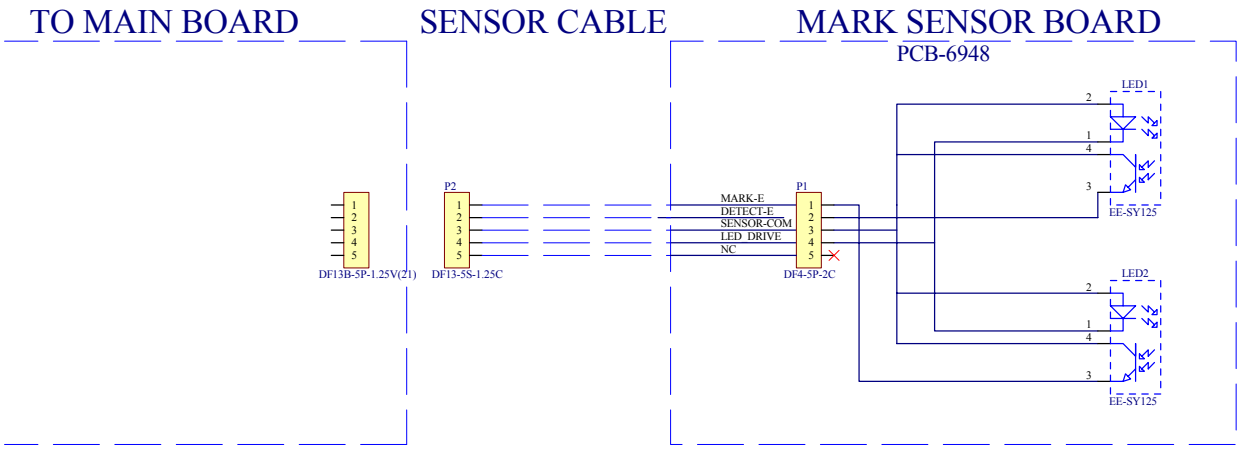
●KEY BOARD (PCB-6949) circuit

The circuit is equipped with key switches for operating this instrument and the LED that indicates the battery status.



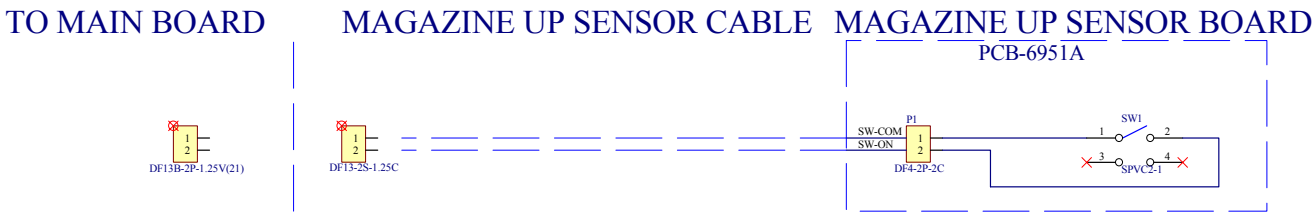
●SENSOR BOARD (PCB-6948) circuit

The circuit is equipped with a sensor that detects the mark position.



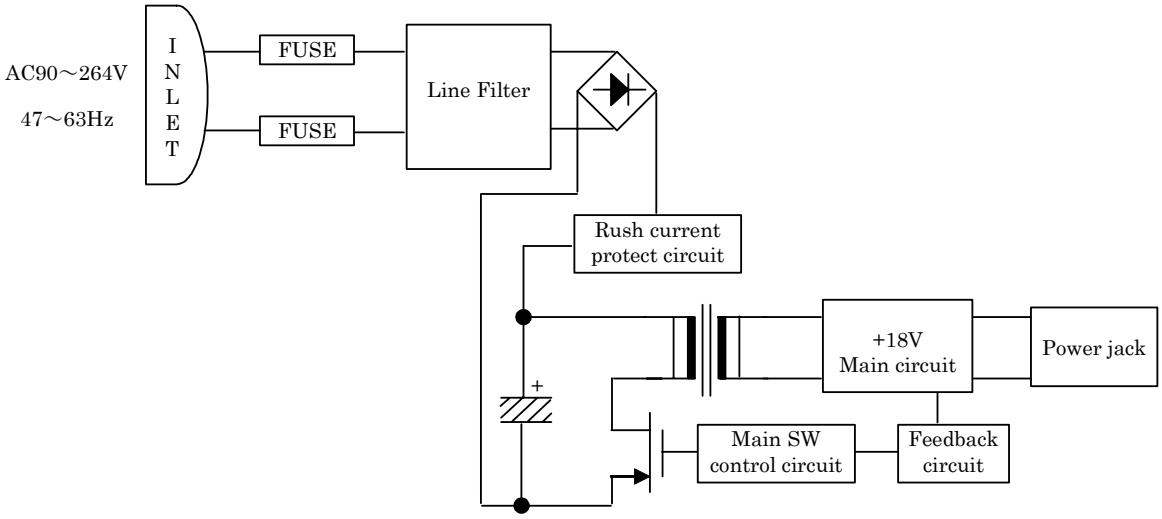
●MAG BOARD (PCB-6951) circuit

The circuit is equipped with a switch that detects open/close status of the magazine.



AC adaptor block diagram

The following is a block diagram of the AC adaptor.
The input of the AC adaptor is worldwide capable, allowing 90V to 264V AC to be input. The +18V voltage generated with the AC adaptor is supplied to this instrument with a power jack.



MAIN BOARD Circuit Diagrams (PCB-6950A)

●Power connection table No.1

MAIN02 MAIN02.SCH | MAIN03 MAIN03.SCH | MAIN04 MAIN04.SCH | MAIN05 MAIN05.SCH | MAIN06 MAIN06.SCH | MAIN07 MAIN07.SCH | MAIN08 MAIN08.SCH | MAIN09 MAIN09.SCH | MAIN10 MAIN10.SCH | ECG11 ECG11.SCH | ECG12 ECG12.SCH | POW13 POW13.SCH | POW14 POW14.SCH | POW15 POW15.SCH | POW16 POW16.SCH | POW17 POW17.SCH | POW18 POW18.SCH | POW19 POW19.SCH | POW20 POW20.SCH | POW21 POW21.SCH

NOTE

1. UNLESS OTHERWISE SPECIFIED
   ALL RESISTOR ARE IN OHMS. ±1% 0.1W
   ALL CAPACITORS ARE IN MICROFARADS.
   ALL VOLTAGE ARE DC.

2. INTERRUPTED LINES CODED WITH THE SAME
   LINE OR LINES COMBINATIONS ARE
   ELECTRICALLY CONNECTED.

3. DEVICE TYPE NUMBER IS FOR REFERENCE ONLY.
   THE NUMBER VARIES WITH THE MANUFACTURE.

4. PART TYPES ARE ABBREVIATED IN THE FIELD OF THE DRAWING.
   FOR FULL PART TYPE, REFER TO TABLE.

5. SPECIAL SYMBOL USAGE.
   ±5VA=±5FLOATING VALTAGE.

TABLE

+24V = +24V

+3.3V +3.3VA +3.3STB +3.3VL +3.3VDF = +3.3V

DG DGF -2.5VF AGL = GND

+5V +5VSTB +5VDF +2.5VF = +5V

E25F =+2.5V

+1.8V = +1.8V

IC	TYPE	+24V	+18V	VTRF	+5V	+5VDF	+3.3V	+3.3VA	+3.3VDF	+3.3VSTB	+3.3VL	+2.5VF	-2.5VF	+1.8V	AGL	DG	DGF	E25F
IC7	HD6417727F100C(CPU)						20,31,44,55,66,77,88,102,117, 134,161,190,209,225,231	237						1,37,93,139, 157,170,175, 178,202		4,18,29,35,42,53,64,75,86,91,100		
IC8	XC2S100E-6TQ144C(FPGA)						17,36,53,72,90,108,128,144							19,46,51,61,8		1,9,16,25,34,45,54,62,70,81,91,9		
IC11	TE28F640J3C-120(FROM)						9,37,43									21,42,48		
IC12	UPD45128163G5-A75-9JF (SDRAM)						1,3,9,14,27,43,49									6,12,28,41,46,52,54		
IC55	LAN91C96TQFP(LAN_CTRL)						11,19,38,48,59,98				71,79,89				78,86,87	6,16,22,29,54,64,92,100		
IC13	RTC-4574SAA(RTC)						7									1		
IC21	MTD2007F(MOTOR_DRIVER)	2,13			15,28											22		
IC38	XC9572XL-10VQ44C (CPLD FOR AMP)								15,26,35								4,17,25	
IC37	TLC3541DGK											6	3					
IC39	TPS77133DGK				5,6				7,8								4	
IC44	BQ2004ESN				13													
IC42	MAX668EUB		9													3		
IC47	LM2674M-5.0	7														6		
IC46	LM2674M-3.3	7														6		
IC45	MAX1952				8											3,6		
IC62	S-873325BUP-ALA	5														2		
IC1	MC34063AD						6											
IC4	M62733ML						1									2		
IC31,32	MAX4521CEE											13	4				5	
IC28,29	MAX4051CEE											16	7,8					

POWER TABLE

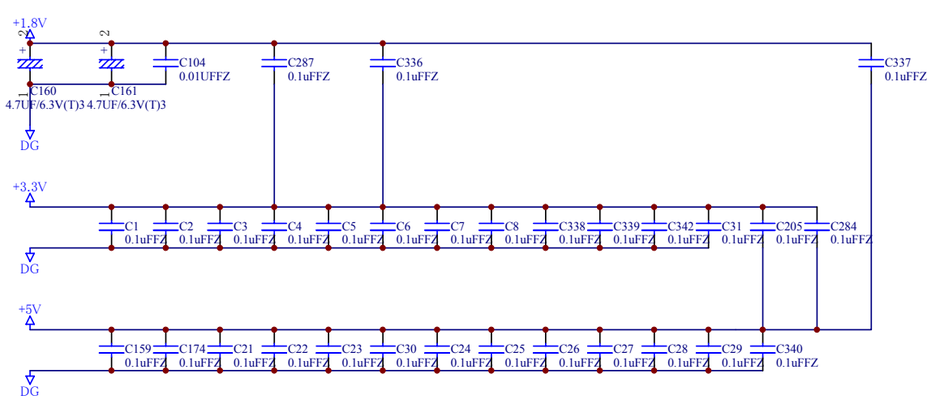
●Power connection tableNo.2

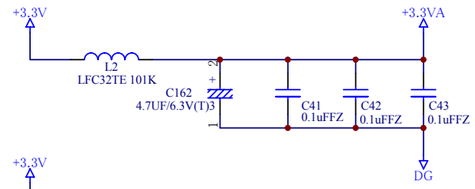
TABLE

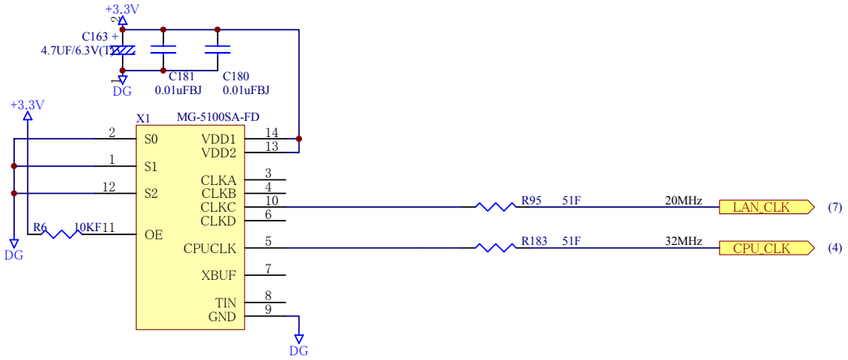
IC	TYPE	+24V	+18V	VTRF	+5V	+5VDF	+5VSTB	+3.3V	+3.3VA	+3.3VDF	+3.3VSTB	+3.3VL	+2.5VF	−2.5VF	+1.8V	AGL	DG	DGF	E25F
IC2,5,18	74HC3G14DP							8									4		
IC3,58	74LVC244APW							20									10		
IC6	74HC08PW							14									7		
IC14,15	LM2904PWR				8												4		
IC16,17	LM2904PWR							8									4		
IC49	LM2904PWR						8										4		
IC51	LM2904PWR	8															4		
IC19	74AHCT14PW						14										7		
IC20,22,70	HD74ACT244TTP-20DA				20												10		
IC23,24,25,26,27	TLC2264CPW												4	11					
IC30	MAX4564EUA												8	3,4					
IC33	HCPL2601 #300					7,8												5	
IC34	HCPL2601 #300				7,8					2							5		
IC35	OPA2350EA												8	4					
IC36	OPA2350EA			8														4	
IC40	AN77L05M					1												2	
IC41	SN74LVC1G125DBVR							5									3		
IC43	NJM78L05UA		3														2		
IC48	LM339PWR						3										12		
IC50	UPC1093						1										2		
IC53	74AHCT00PW						14										7		
IC56	74AHCT02PW						14										7		
IC57	SN74LV02APW										14						7		
IC59	74LVC240APW										20						10		
IC60	SN74LV132APWR										14						7		
IC61	TLC393IPWLE										8						4		
IC64	74HC4040PW										16						8		
IC69	TC7W74FU										8						4		

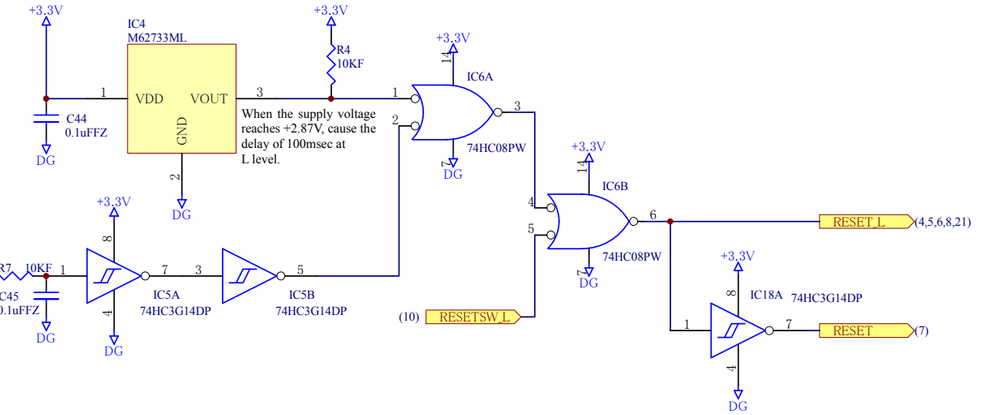
POWER TABLE

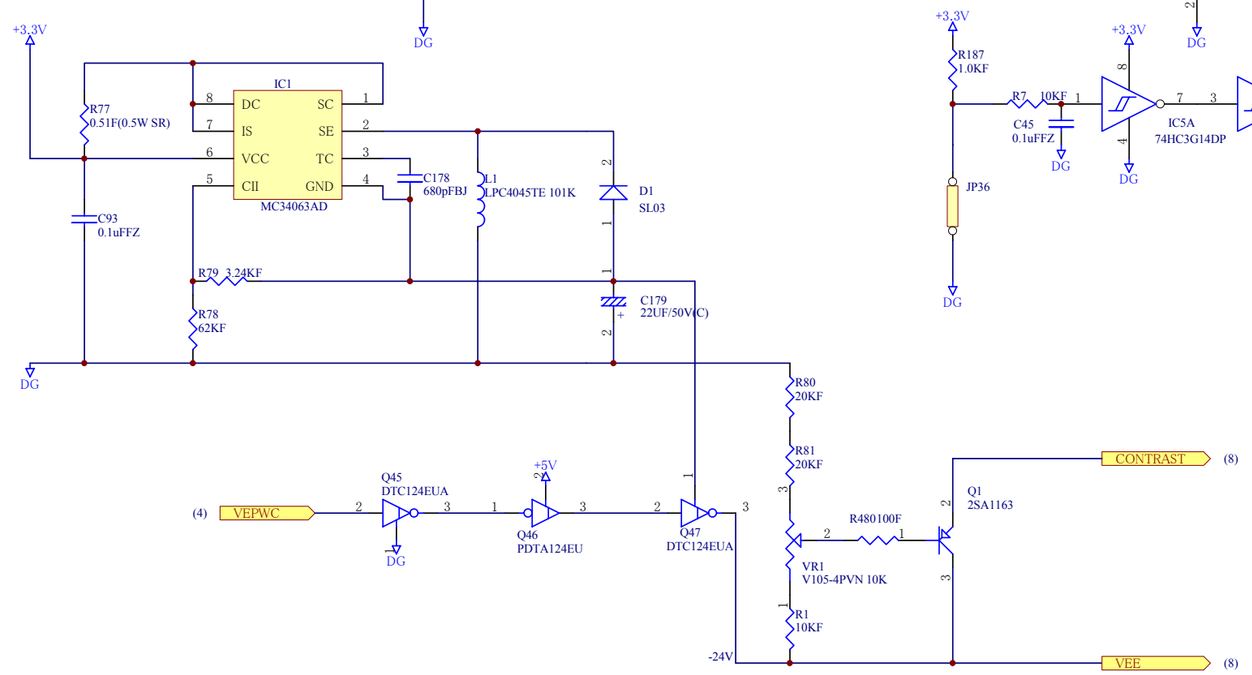
●POWER / CAPACITOR / RESET IC / CLOCK / LCD POWER block

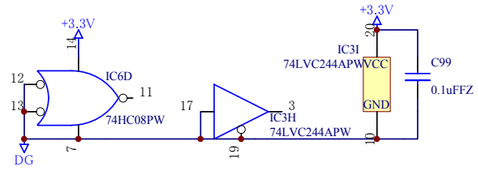






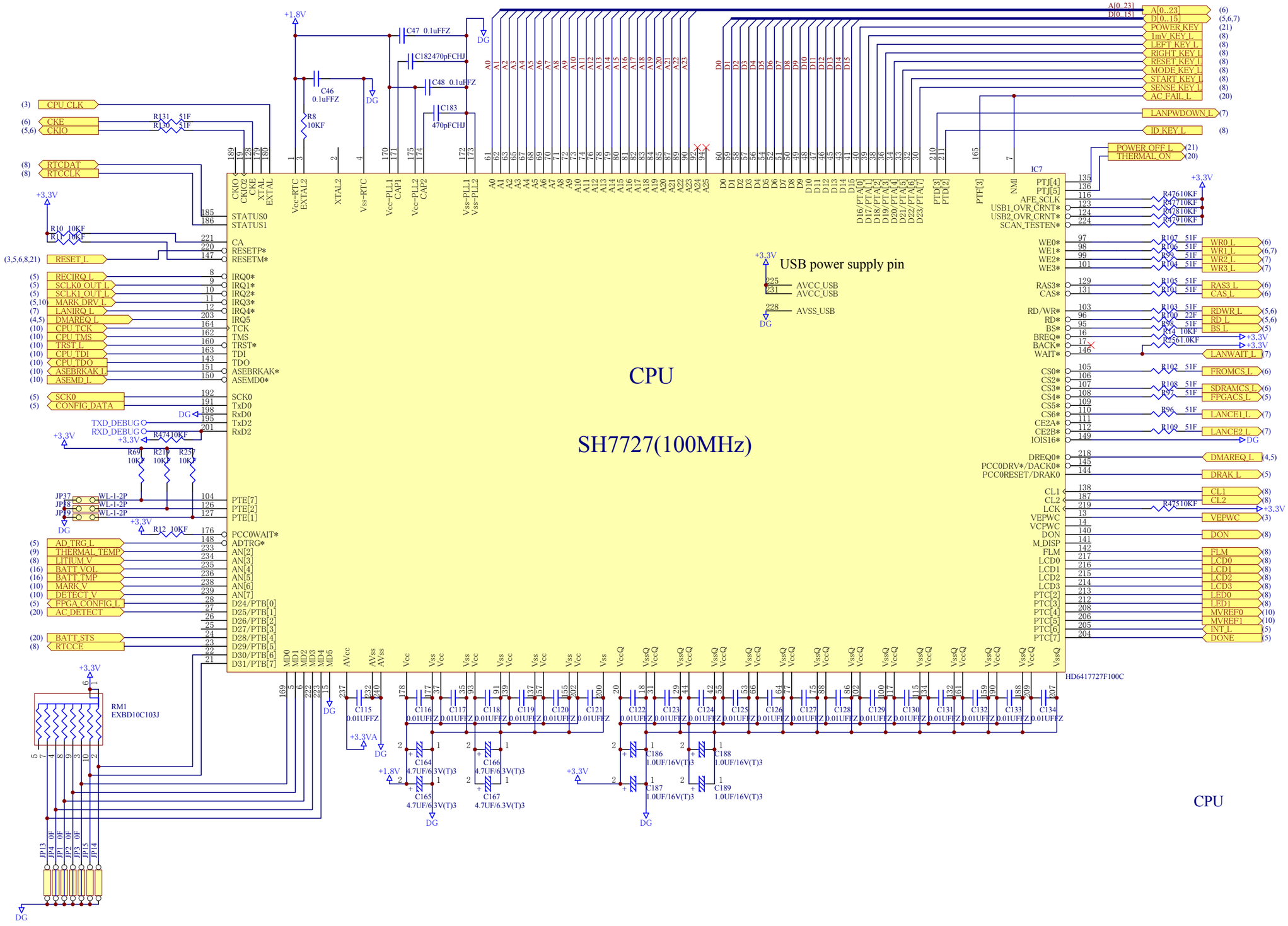




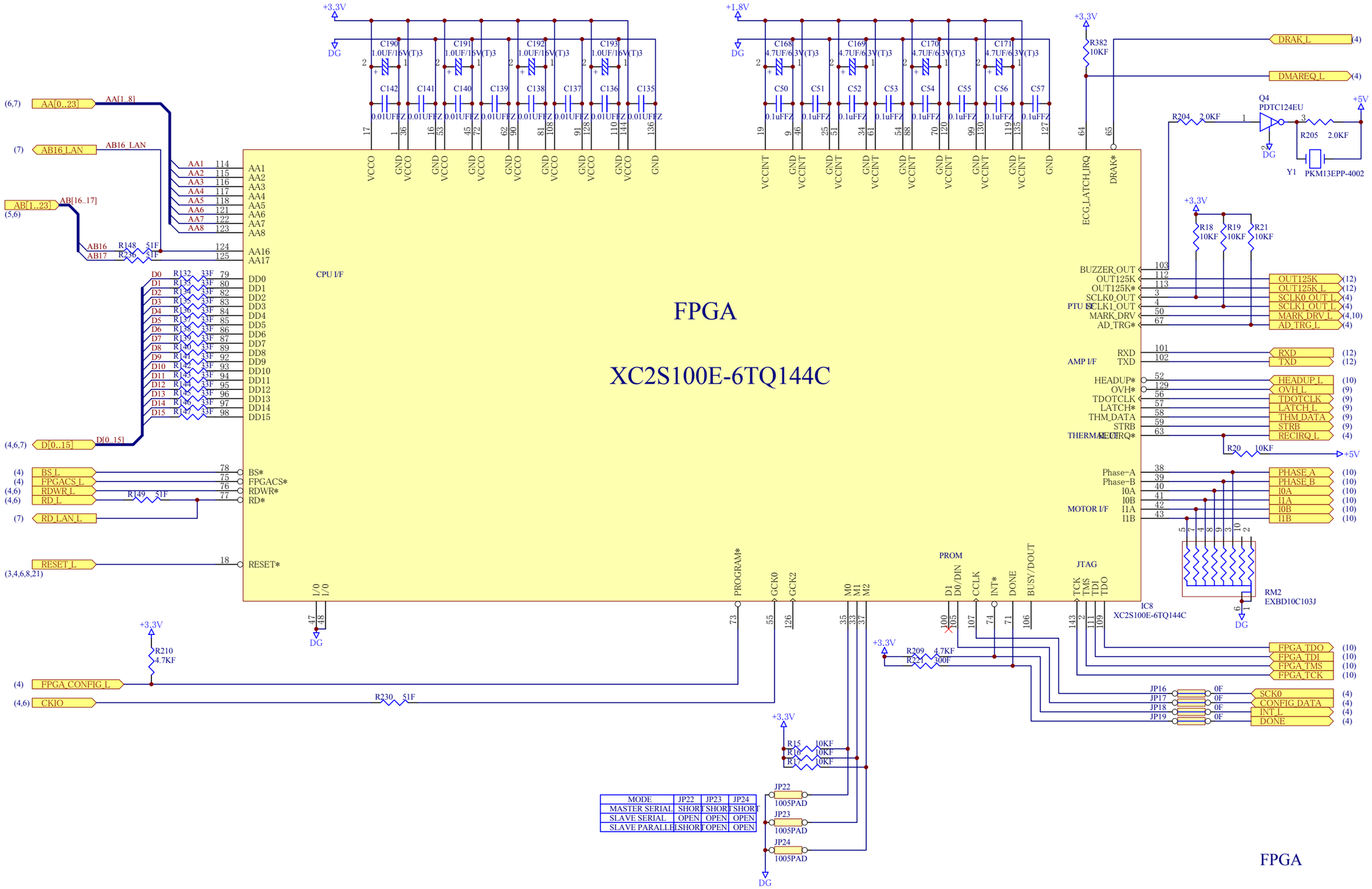


POWER
+3.3VA
VEE
LCD CONTRAST
CLK
RESET IC

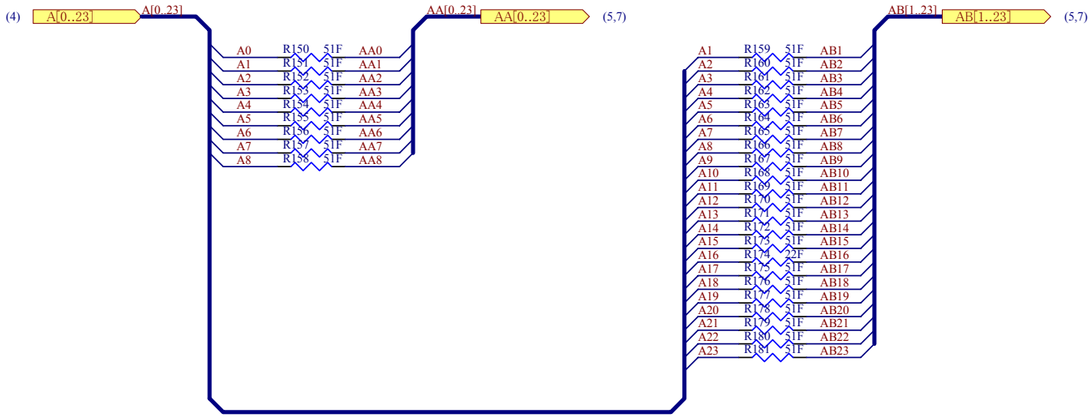
●CPU block


CPU
SH7727(100MHz)
HD6417727F100C
USB power supply pin
+1.8V
+3.3V
+3.3VA
DG
CPU_CLK
CKE
CKIO
RTCDAT
RTCCLK
RESET_L
RECIRQ_L
SCLK0_OUT_L
SCLK1_OUT_L
MARK_DRV_L
LANIRQ_L
DMAREQ_L
CPU_TCK
CPU_TMS
TRST_L
CPU_TDI
CPU_TDO
ASEBRKAK_L
ASEMD_L
SCK0
CONFIG_DATA
TXD_DEBUG
RXD_DEBUG
AD_TRG_L
THERMAL_TEMP
LITIUM_V
BATT_VOL
BATT_TMP
MARK_V
DETECT_V
FPGA_CONFIG_L
AC_DETECT
BATT_STS
RTCCE
A[0..23]
D[0..15]
POWER_KEY
1mV_KEY_L
LEFT_KEY_L
RIGHT_KEY_L
RESET_KEY_L
MODE_KEY_L
START_KEY_L
SENSE_KEY_L
AC_FAIL_L
LANPWDOWN_L
ID_KEY_L
POWER_OFF_L
THERMAL_ON
WR0_L
WR1_L
WR2_L
WR3_L
RAS3_L
CAS_L
RDWR_L
RD_L
BS_L
LANWAIT_L
FROMCS_L
SDRAMCS_L
FPGACS_L
LANCE1_L
LANCE2_L
DMAREQ_L
DRAK_L
CL1
CL2
VEPWC
DON
FLM
LCD0
LCD1
LCD2
LCD3
LED0
LED1
MVREF0
MVREF1
INT_L
DONE
RM1
EXBD10C103J
JP13
JP4
JP1
JP2
JP3
JP15
JP14

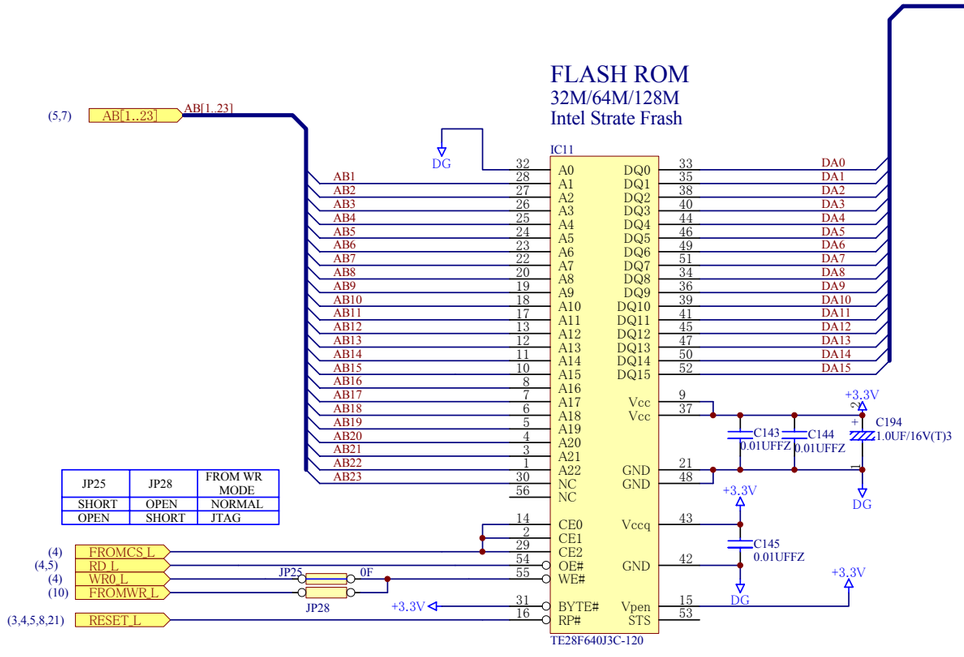
●FPGA block


FPGA
XC2S100E-6TQ144C
CPU I/F
AMP I/F
MOTOR I/F
PROM
JTAG
IC8
XC2S100E-6TQ144C
RM2
EXBD10C103J
Y1
PKM13EPP-4002
PDTC124EU
MODE JP22 JP23 JP24
MASTER SERIAL SHORT SHORT SHORT
SLAVE SERIAL OPEN OPEN OPEN
SLAVE PARALLEL SHORT OPEN OPEN
FPGA

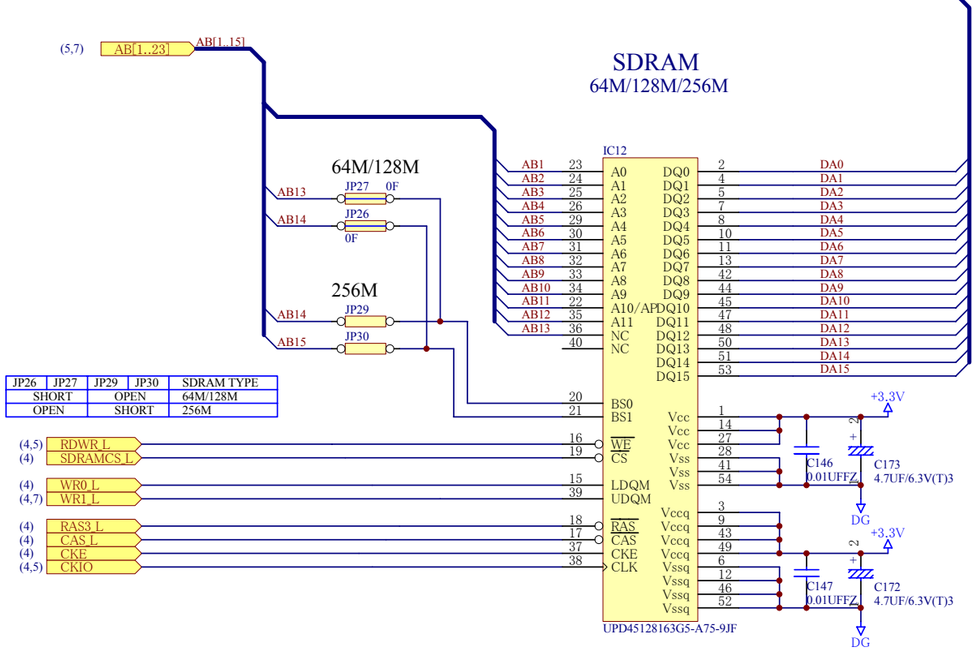
●MEMORY block



FLASH ROM
32M/64M/128M
Intel Strate Frash



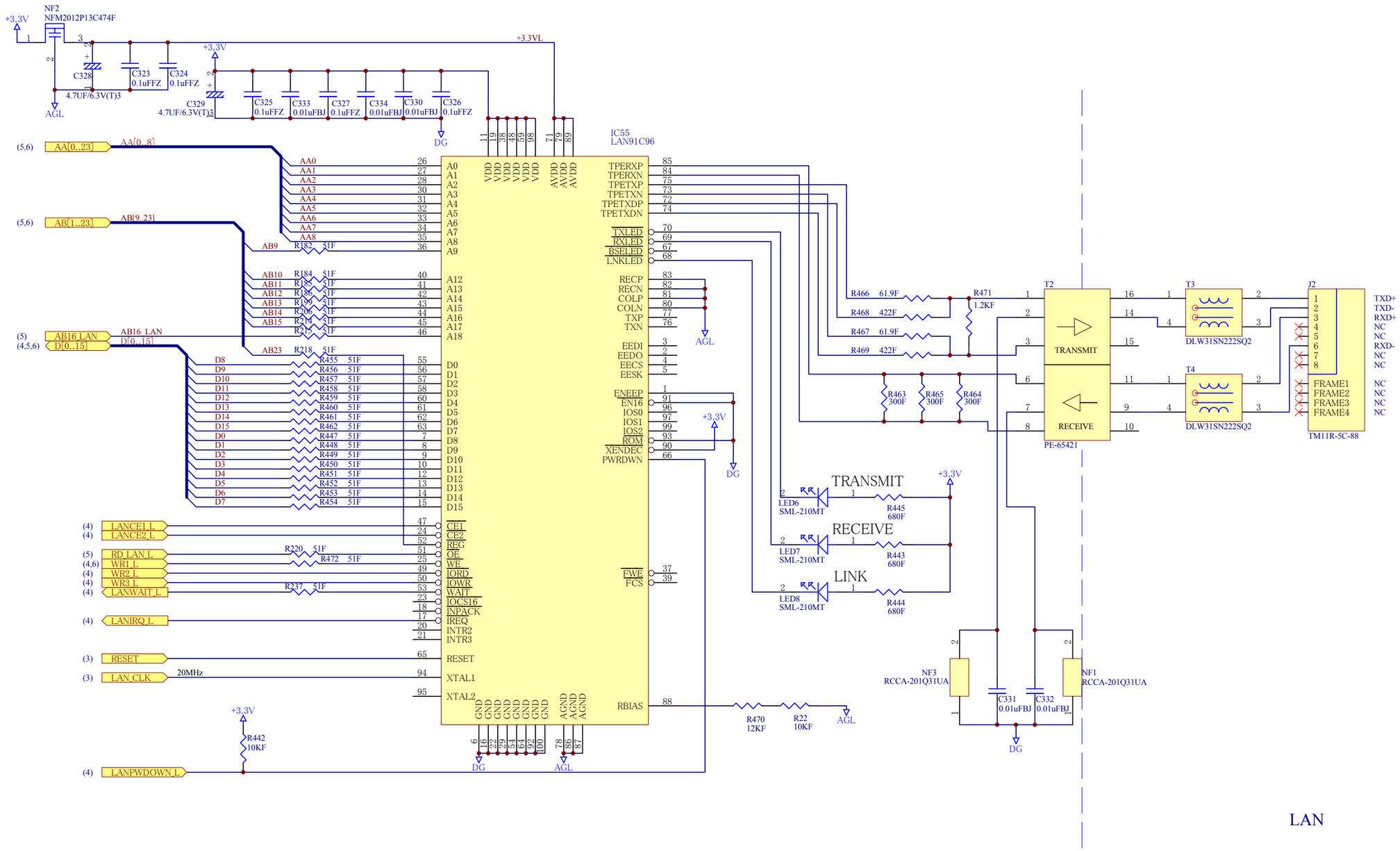
SDRAM
64M/128M/256M



FLASH ROM

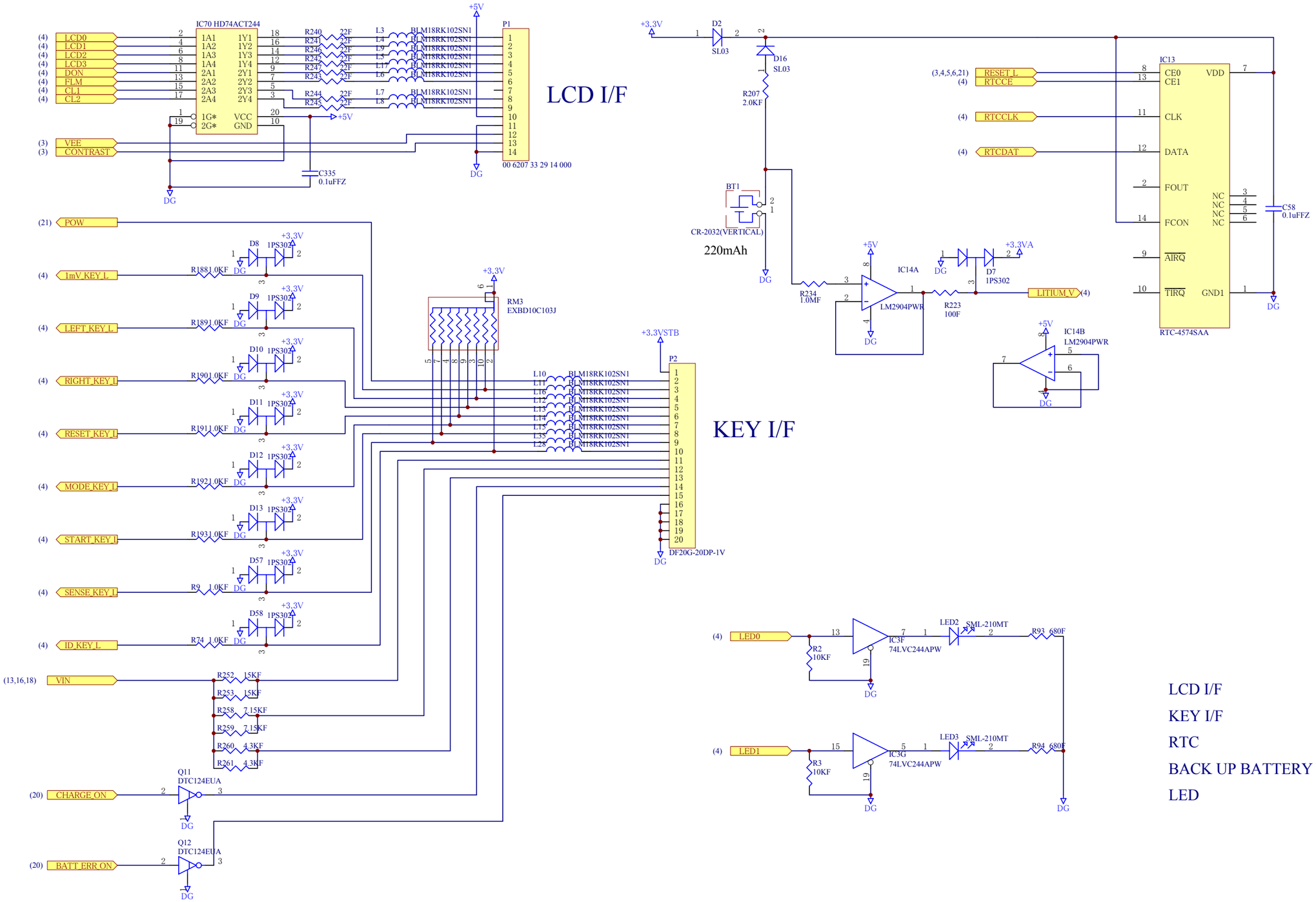
SDRAM

●LAN CONTROL block

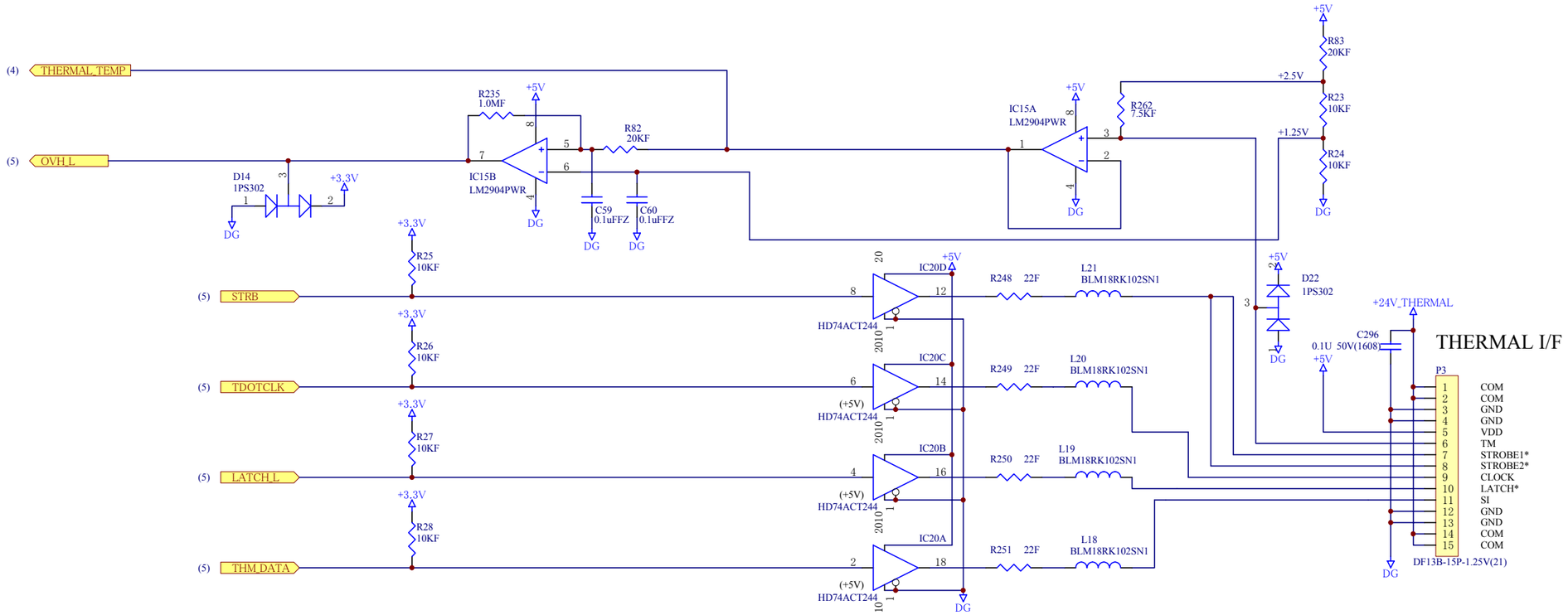


LAN

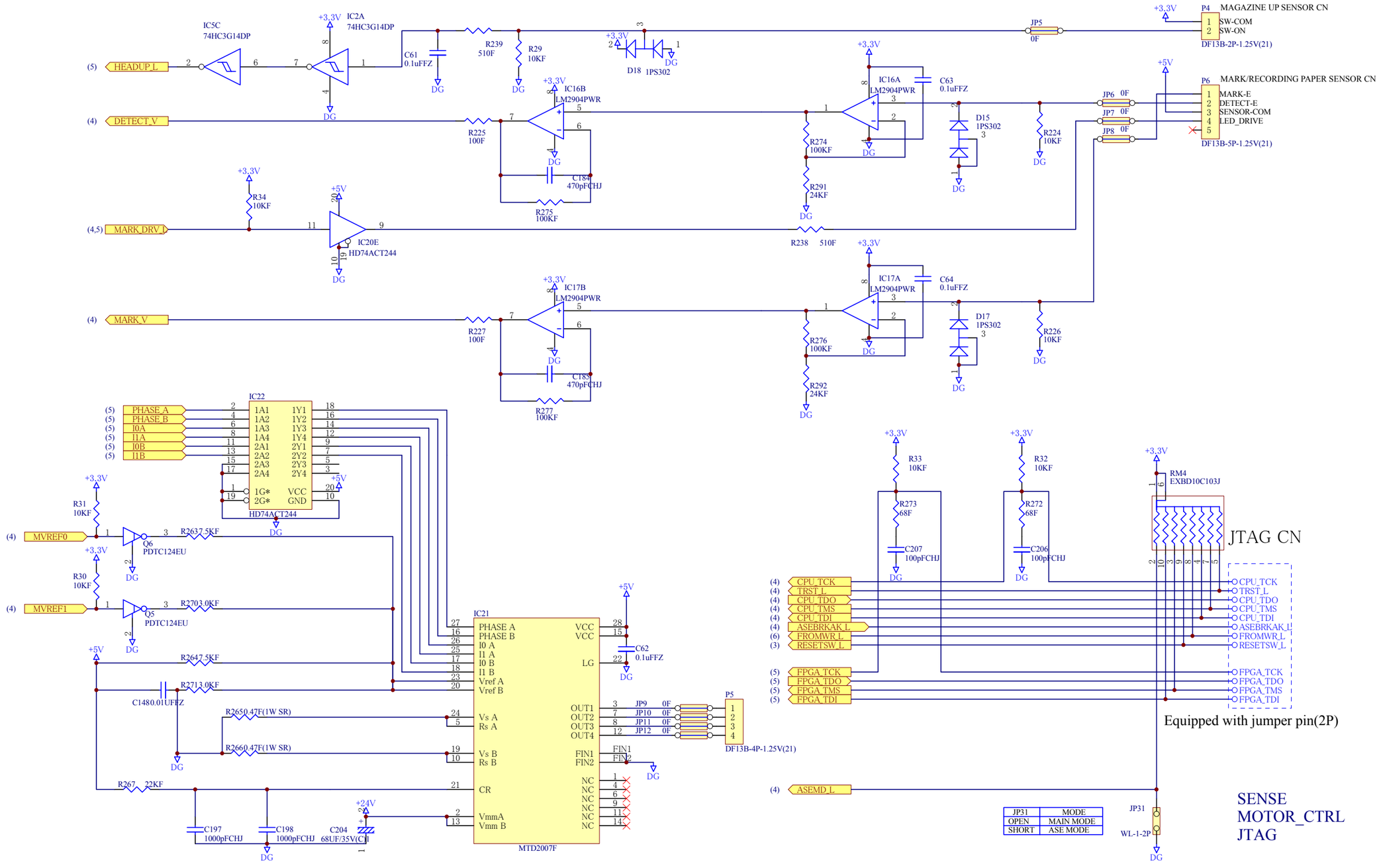
●LCD I/F / KEY I/F / RTC / LED block



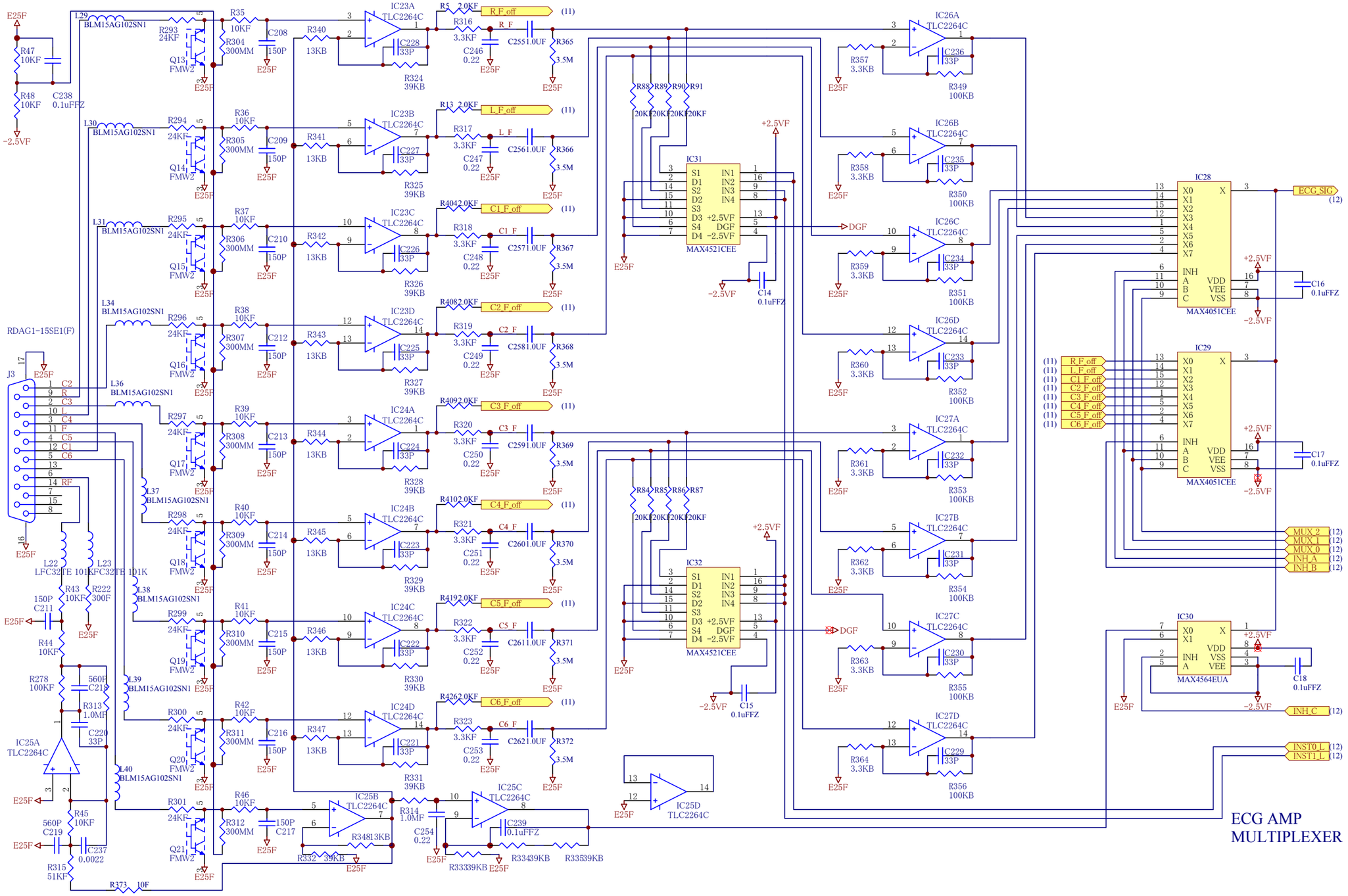
●THERMAL I/F block



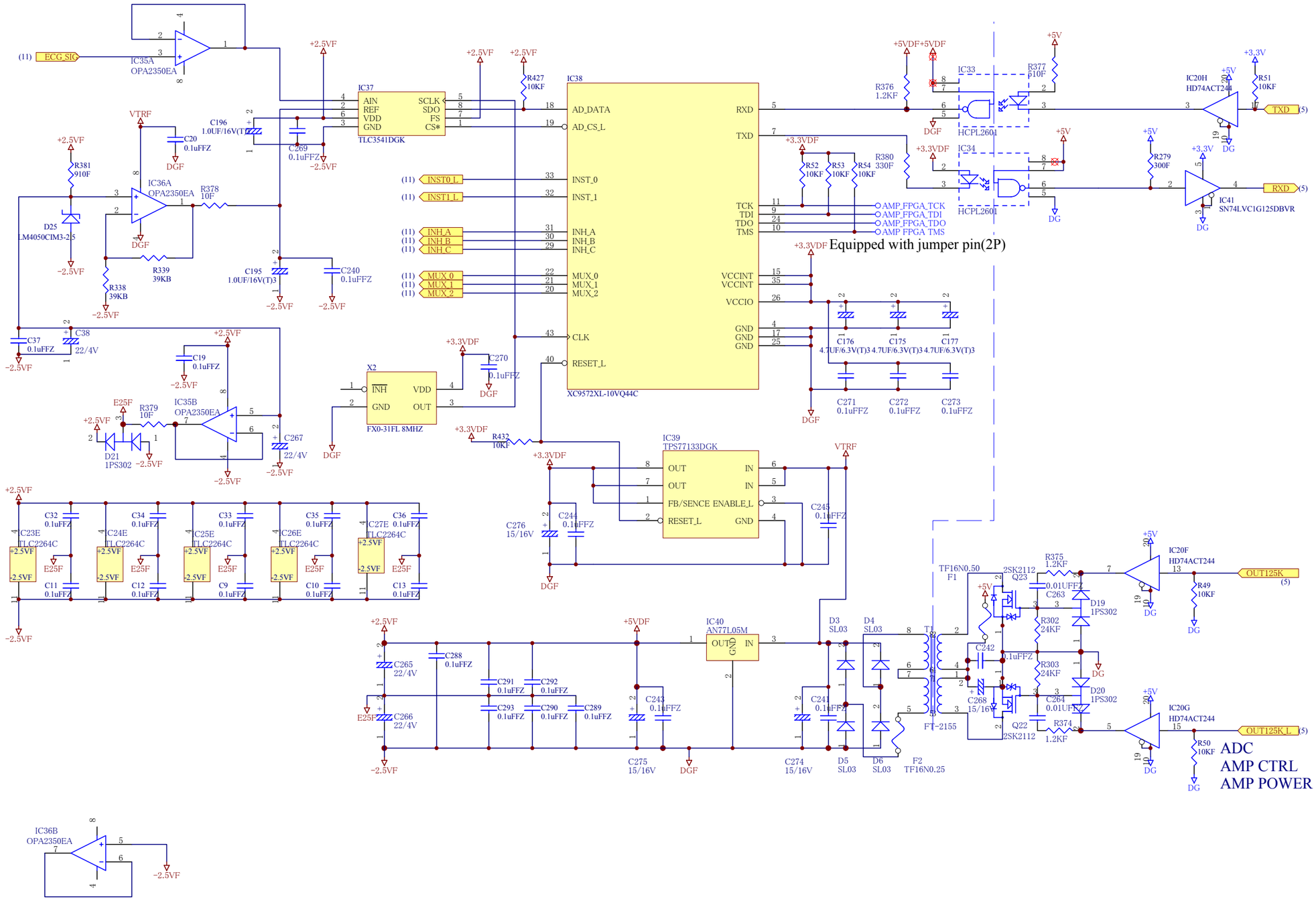
●SENSOR I/F / MAGAZIN UP SENSOR I/F / MOTOR I/F / JTAG I/F block



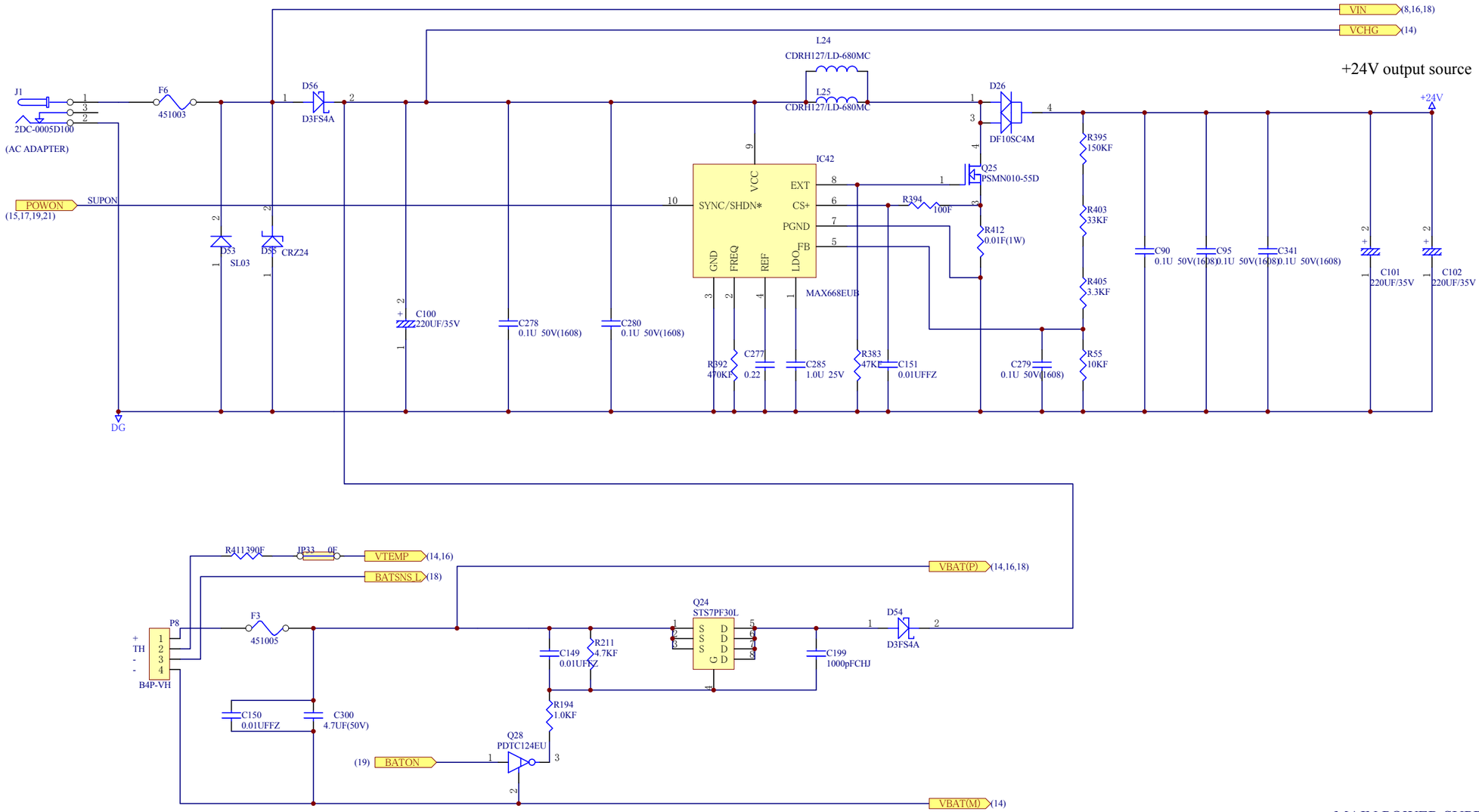
●ECG AMP block (Differential amplifition, multiplexer section)



●ECG AMP block (ADC, CPLD and POWER section)

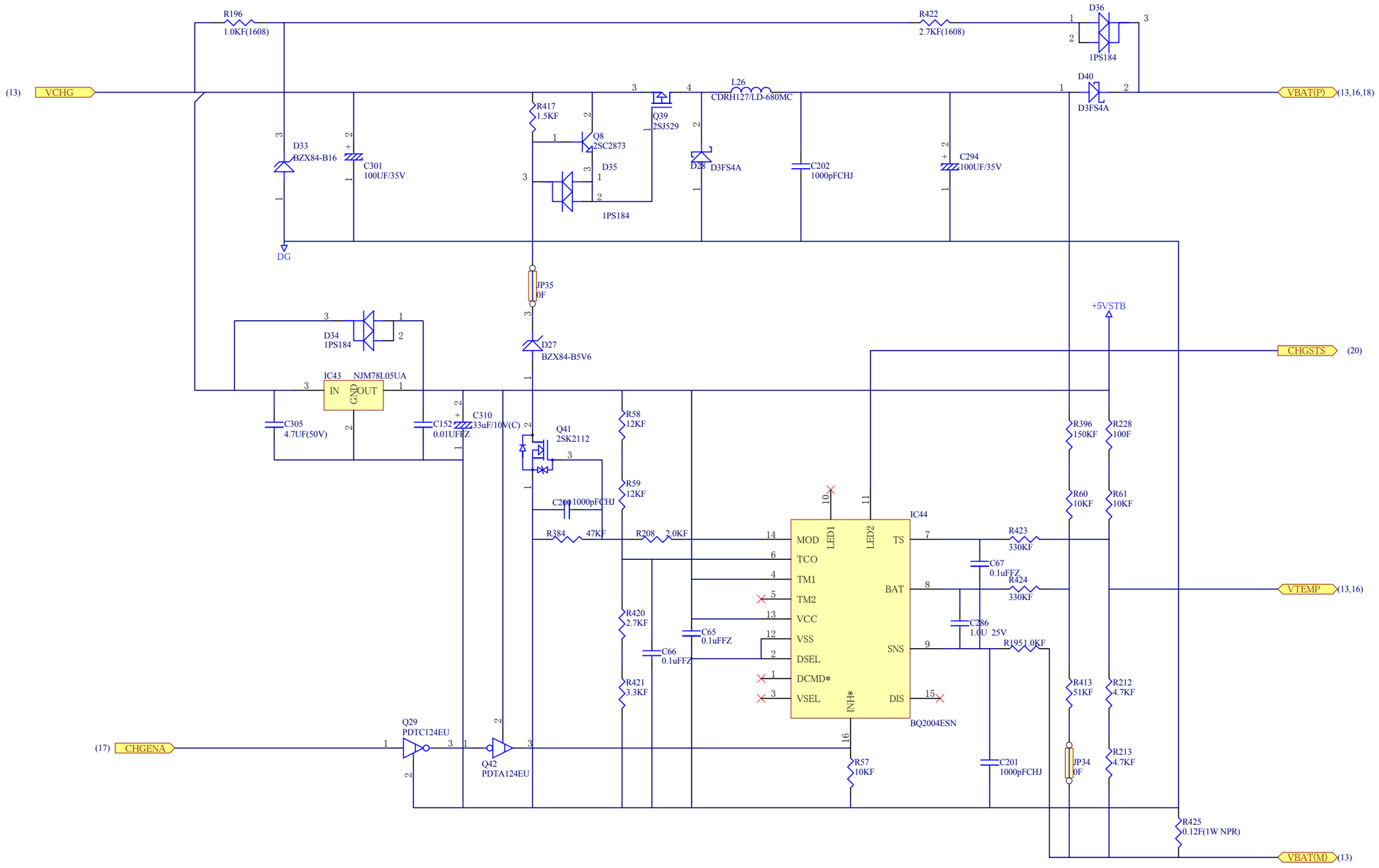


●MAIN POWER SUPPLY +24V block



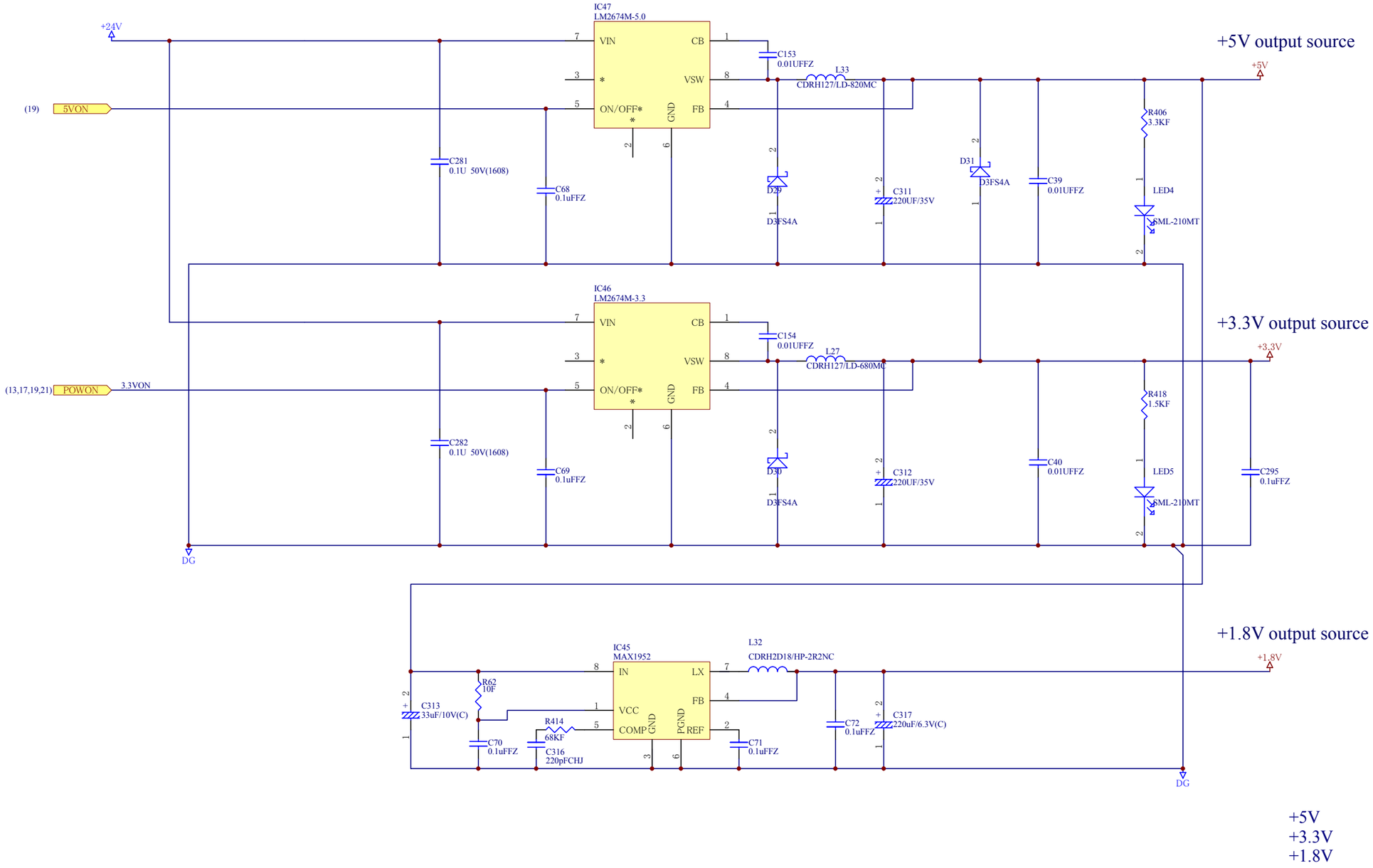
MAIN POWER SUPPLY
+24V

●CHARGE block



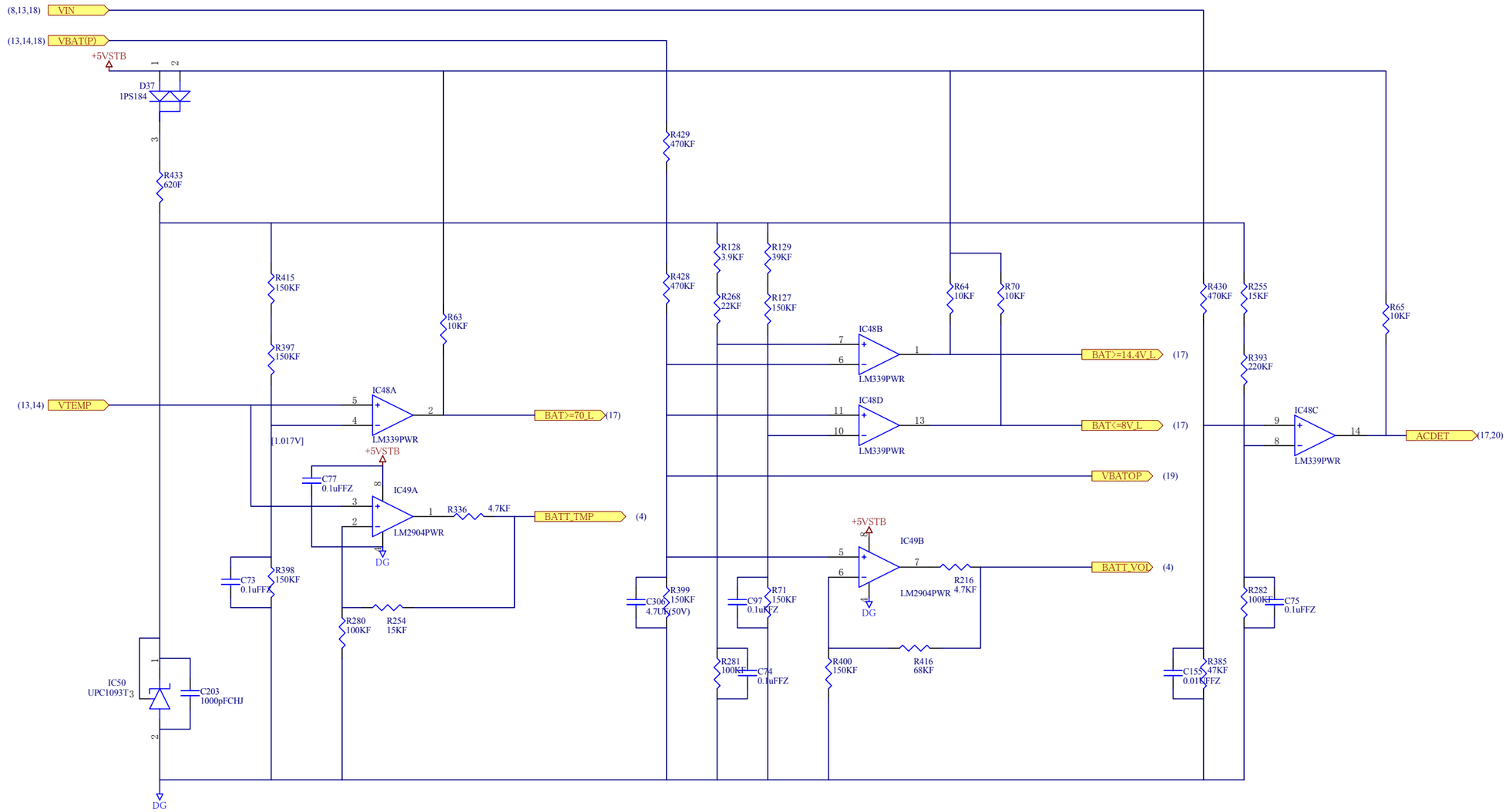
CHARGE

●+5V / +3.3V / +1.8VPower generation block



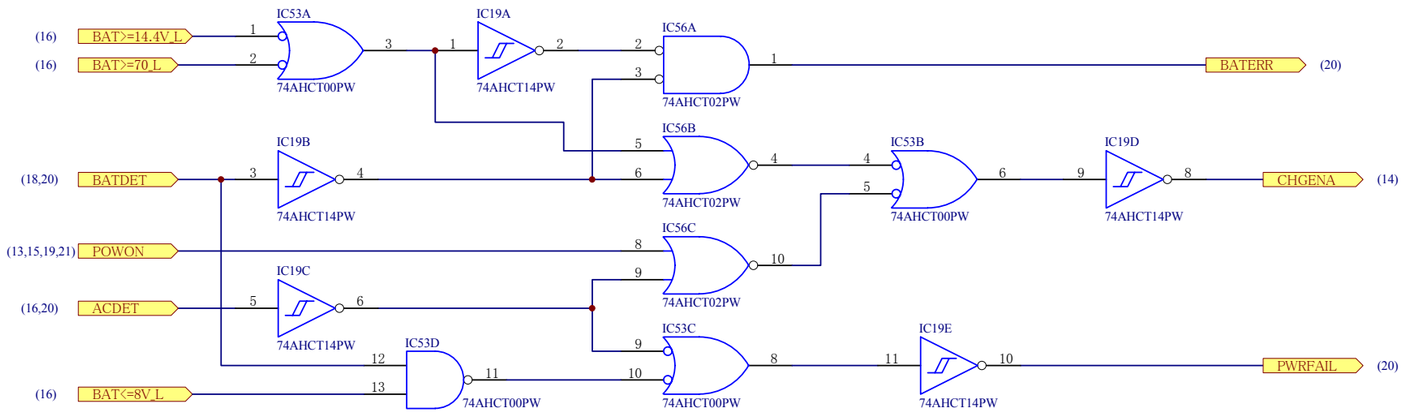
+5V
+3.3V
+1.8V

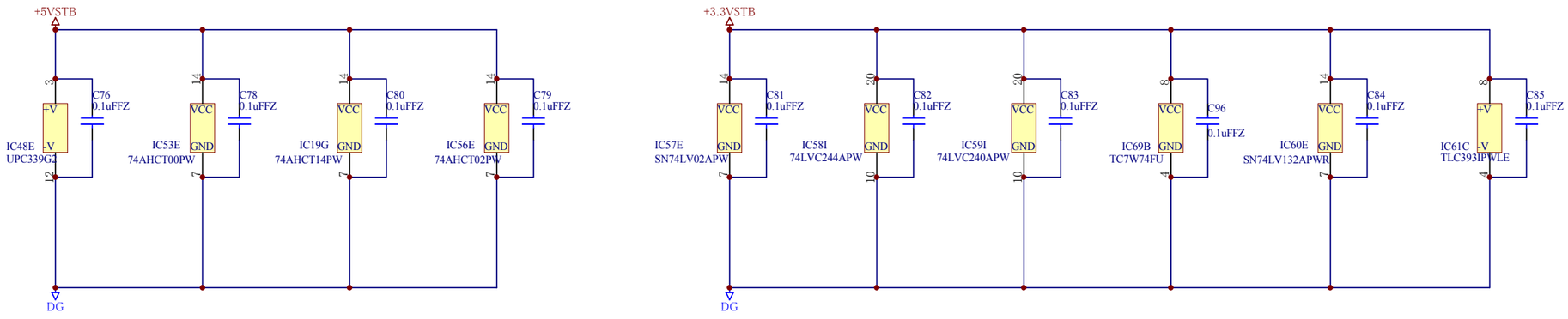
●POWER STATUS block

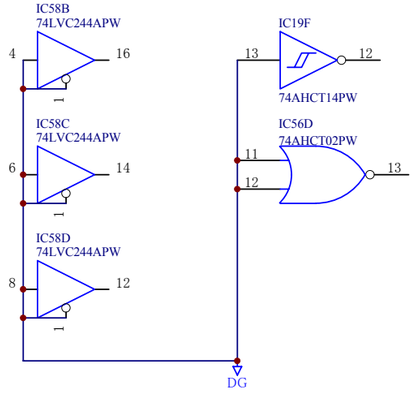


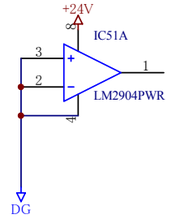
AC/DC STATUS

●POWER / CHARGE ERROR block



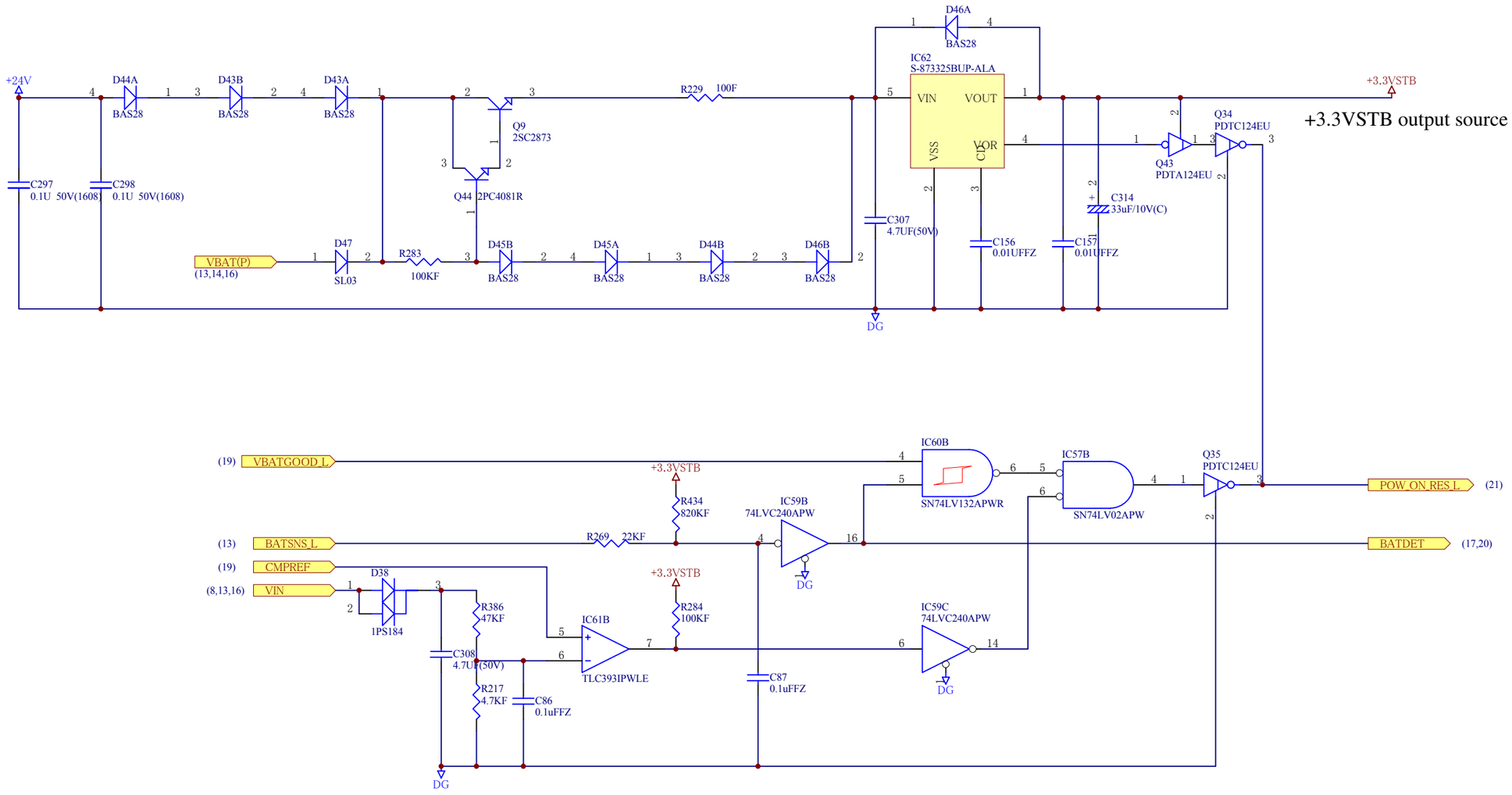






AC/DC FAIL

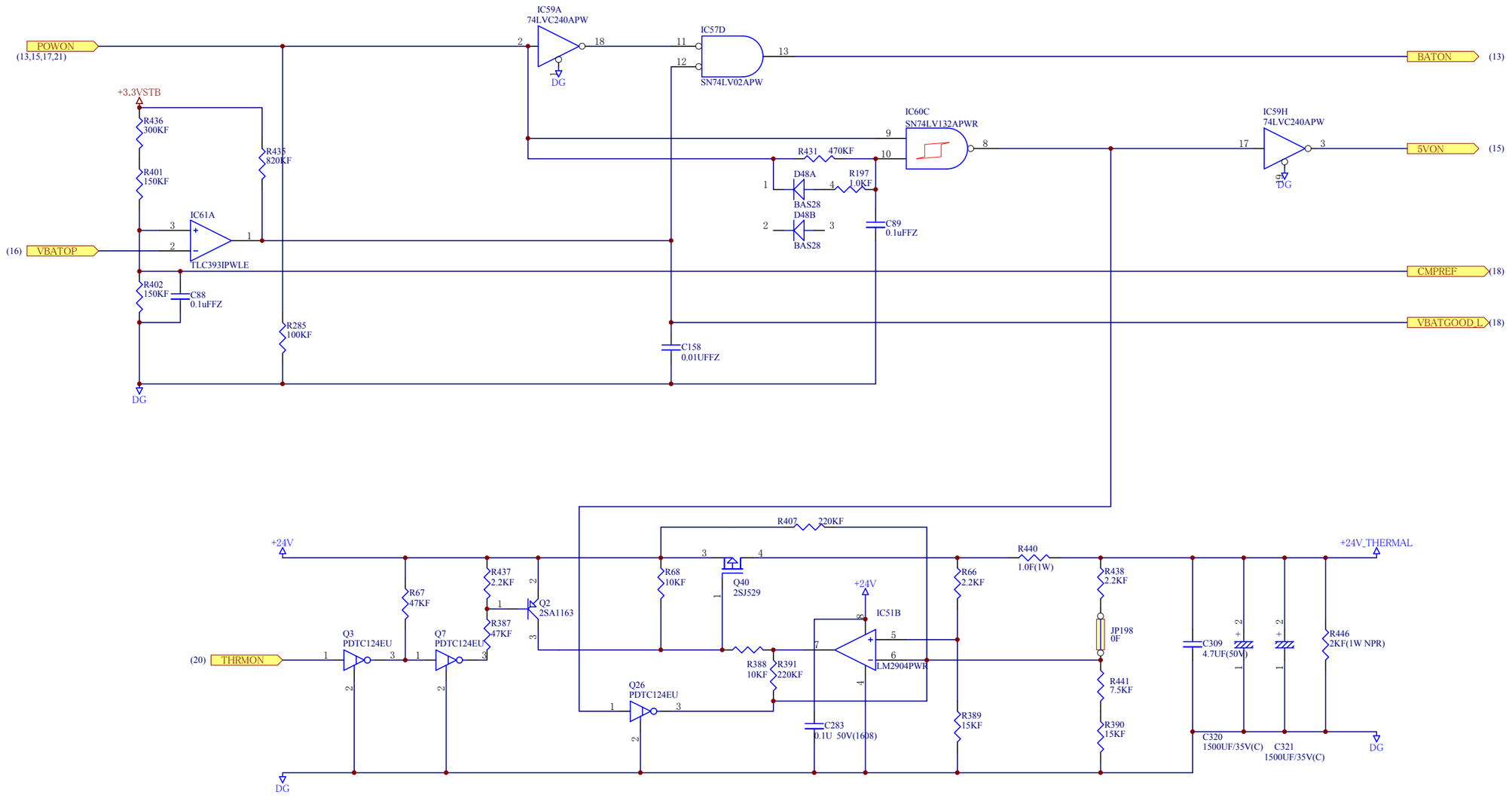
●+3.3VSTB / POWER ON RESET block



+3.3VSTB output source

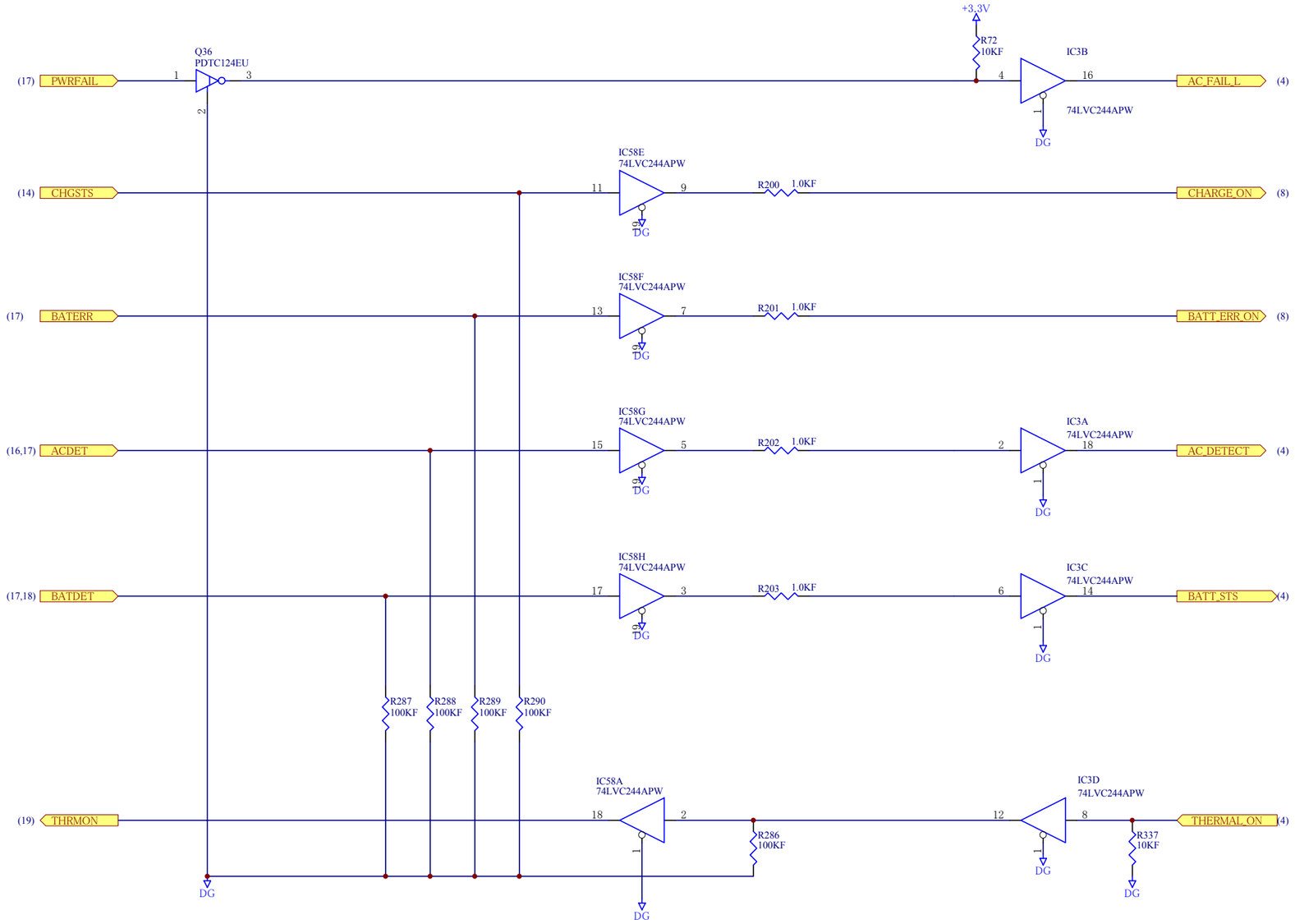
+3.3VSTB
POWER ON RESET

●BATTERY ON CONTROL/ THERMAL POWERGENERATION BLOCK



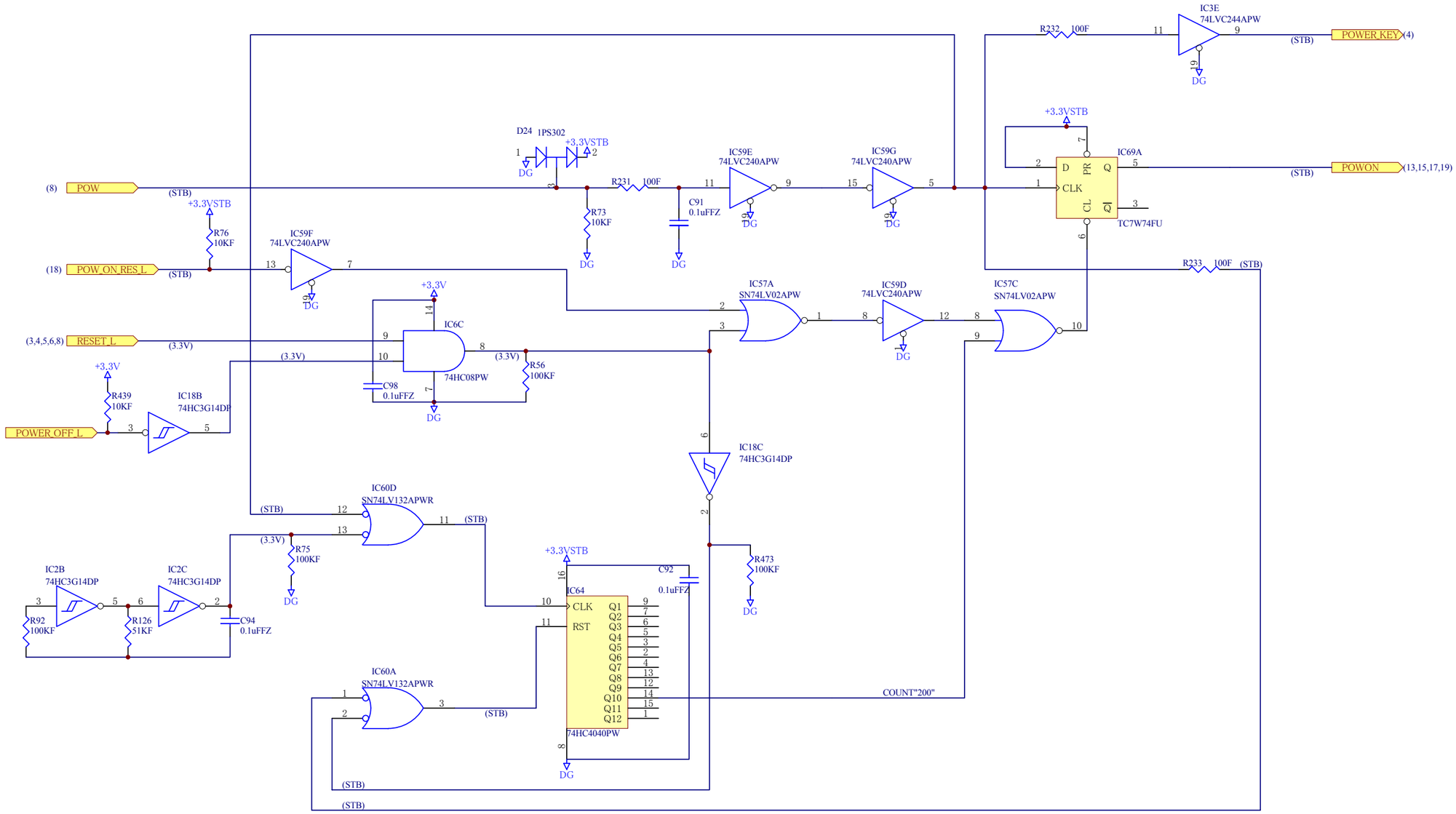
BATTERY ON CTRL
THERMAL

●POWER-MAIN I/F block



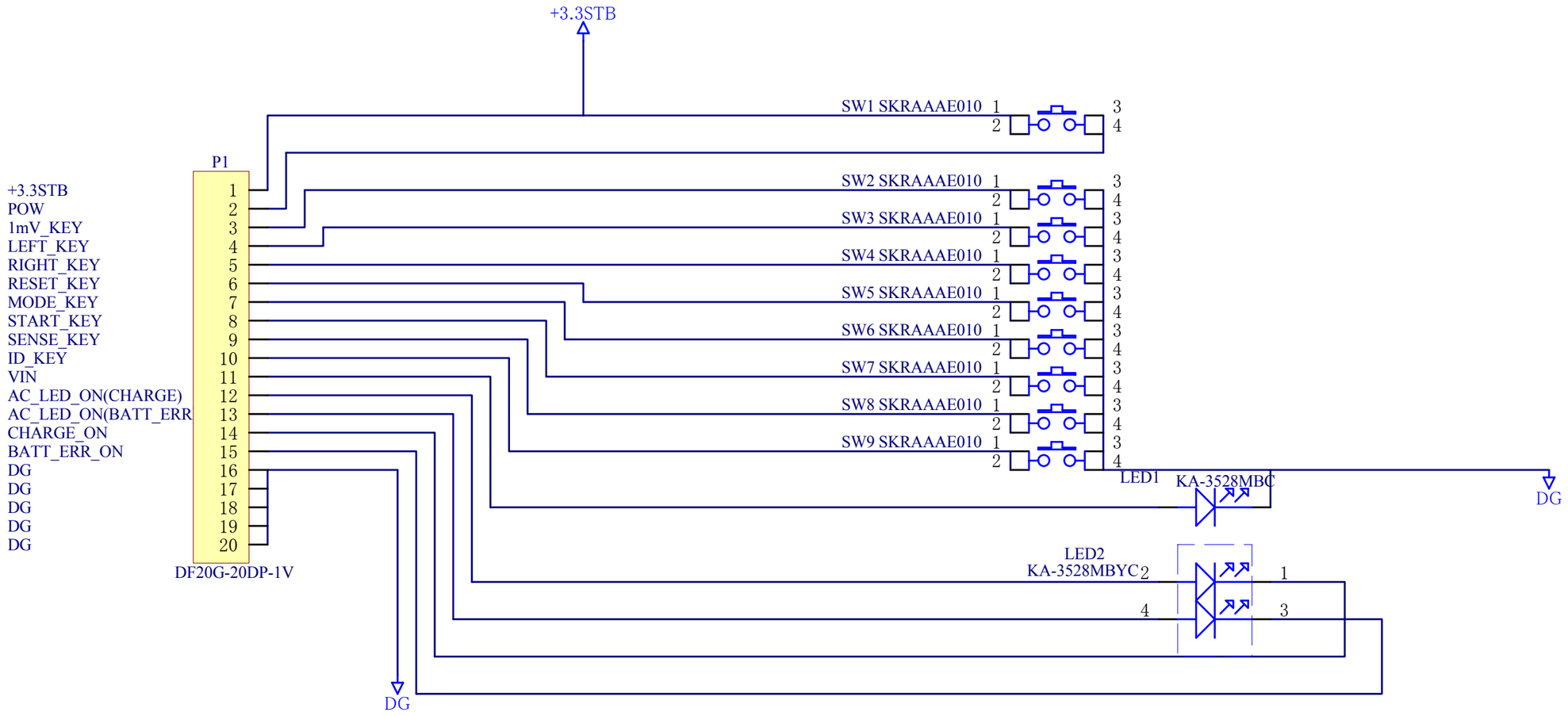
POWER-MAIN I/F

●POWER ON/OFF CONTROL block

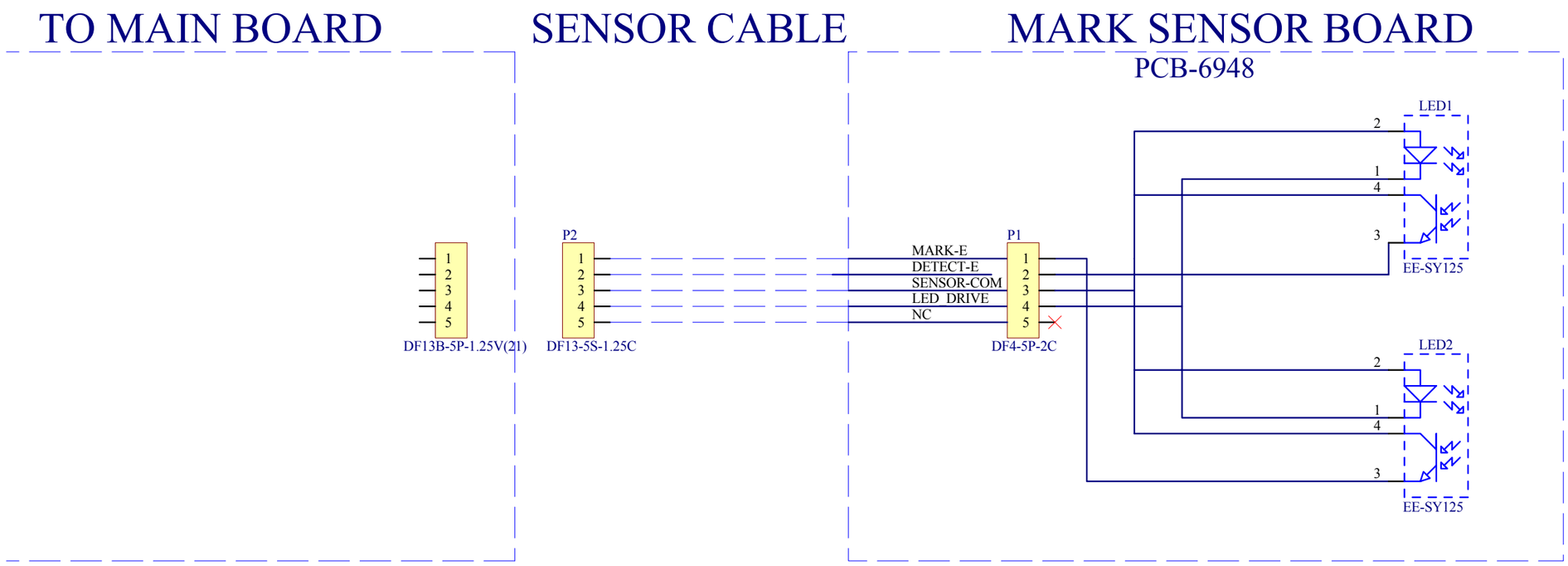


POWER ON/OFF CTRL

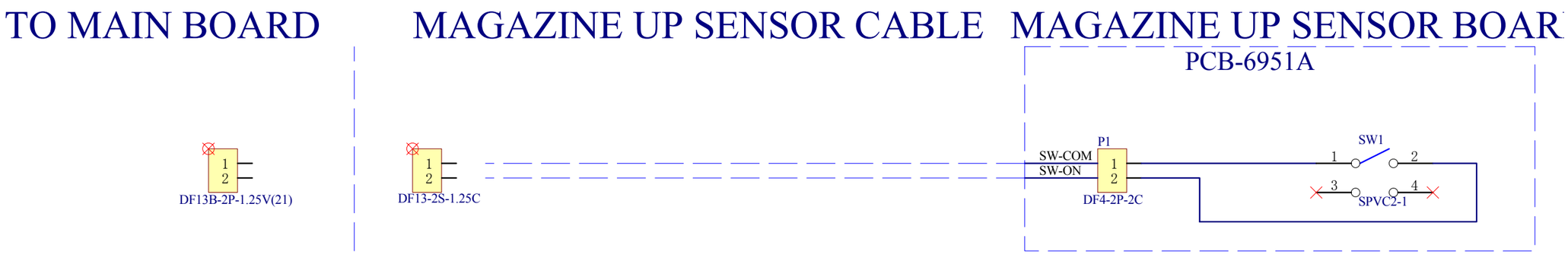
KEY BOARD (PCB-6949)



SENSOR BOARD (PCB-6948)



MAG UP BOARD (PCB-6951)



Chapter 6

Spare Parts List

MAIN BOARD (PCB-6950)..... 6-1

KEY BOARD (PCB-6949)..... 6-8

SENSOR BOARD (PCB-6948)..... 6-9

MAG UP BOARD (PCB-6951)..... 6-10

Other spare parts list 6-11

MAIN BOARD (PCB-6950)

Config. No.						Part name	Specification	Q'ty
R	304	305	306	307	308	Square chip resistor	TSR6GTM-307V 300M Ω M	9
	309	310	311	312				
R	425					Square chip resistor	NPR1 0.12Ω F	1
R	446					Square chip resistor	NPR1 2K Ω J	1
R	77					Square chip resistor	SR73H2E TD 0.51 Ω F	1
R	265	266				Power chip resistor	SR73H3ATE 0.47 Ω F	2
R	357	358	359	360	361	Square chip resistor	RN73F2A TD 3.3 K Ω B	8
	362	363	364					
R	340	341	342	343	344	Square chip resistor	RN73F2A TD 13 K Ω B	9
	345	346	347	348				
R	324	325	326	327	328	Square chip resistor	RN73F2A TD 39 K Ω B	14
	329	330	331	332	333			
	334	335	338	339				
R	349	350	351	352	353	Square chip resistor	RN73F2A TD 100 K Ω B	8
	354	355	356					
R	196					Square chip resistor	RK73H1J TD 1.0 K Ω F	1
R	422					Square chip resistor	RK73H1J TD 2.7 K Ω F	1
R	223	225	227	228	229	Square chip resistor	RK73H1E TD 100ΩF	10
	231	232	233	394	480			
R	9	74	187	188	189	Square chip resistor	RK73H1E TD 1.0KΩF	17
	190	191	192	193	194			
	195	197	200	201	202			
	203	256						
R	417	418				Square chip resistor	RK73H1E TD 1.5KΩF	2
R	270	271				Square chip resistor	RK73H1E TD 3.0KΩF	2
R	1	2	3	4	6	Square chip resistor	RK73H1E TD 10KΩF	81
	7	8	10	11	12			
	14	15	16	17	18			
	19	20	21	22	23			
	24	25	26	27	28			
	29	30	31	32	33			
	34	35	36	37	38			
	39	40	41	42	43			
	44	45	46	47	48			
	49	50	51	52	53			
	54	55	57	60	61			
	63	64	65	68	69			
	70	72	73	76	219			
	224	226	257	337	382			
	388	427	432	439	442			
	474	475	476	477	478			
	479							
R	252	253	254	255	389	Square chip resistor	RK73H1E TD 15KΩF	6
	390							
R	267	268	269			Square chip resistor	RK73H1E TD 22KΩF	3
R	291	292	293	294	295	Square chip resistor	RK73H1E TD 24KΩF	13
	296	297	298	299	300			
	301	302	303					
R	126	315	413			Square chip resistor	RK73H1E TD 51KΩF	3

Config. No.						Part name	Specification	Q'ty
R	56	75	92	274	275	Square chip resistor	RK73H1E TD 100KΩF	20
	276	277	278	280	281			
	282	283	284	285	286			
	287	288	289	290	473			
R	436					Square chip resistor	RK73H1E TD 300KΩF	1
R	411					Square chip resistor	RK73H1E TD 390ΩF	1
R	234	235	313	314		Square chip resistor	RK73H1E TD 1.0MΩF	4
R	5	13	204	205	207	Square chip resistor	RK73H1E TD 2.0KΩF	12
	208	404	408	409	410			
	419	426						
R	128					Square chip resistor	RK73H1E TD 3.9KΩF	1
R	209	210	211	212	213	Square chip resistor	RK73H1E TD 4.7KΩF	8
	216	217	336					
R	80	81	82	83	84	Square chip resistor	RK73H1E TD 20KΩF	12
	85	86	87	88	89			
	90	91						
R	403					Square chip resistor	RK73H1E TD 33KΩF	1
R	71	127	395	396	397	Square chip resistor	RK73H1E TD 150KΩF	11
	398	399	400	401	402			
	415							
R	391	393	407			Square chip resistor	RK73H1E TD 220KΩF	3
R	423	424				Square chip resistor	RK73H1E TD 330KΩF	2
R	93	94	443	444	445	Square chip resistor	RK73H1E TD 680ΩF	5
R	374	375	376	471		Square chip resistor	RK73H1E TD 1.2KΩF	4
R	58	59	470			Square chip resistor	RK73H1E TD 12KΩF	3
R	420					Square chip resistor	RK73H1E TD 2.7KΩF	1
R	316	317	318	319	320	Square chip resistor	RK73H1E TD 3.3KΩF	11
	321	322	323	405	406			
	421							
R	132	133	134	135	136	Square chip resistor	RK73H1E TD 33ΩF	16
	137	138	139	140	141			
	142	143	144	145	146			
	147							
R	260	261				Square chip resistor	RK73H1E TD 4.3KΩF	2
R	468	469				Square chip resistor	RK73H1E TD 422ΩF	2
R	392	428	429	430	431	Square chip resistor	RK73H1E TD 470KΩF	5
R	67	383	384	385	386	Square chip resistor	RK73H1E TD 47KΩF	6
	387							

Config. No.						Part name	Specification	Q'ty
R	95	96	97	98	99	Square chip resistor	RK73H1E TD 51ΩF	96
	101	102	103	104	105			
	106	107	108	109	110			
	111	112	113	114	115			
	116	117	118	119	120			
	121	122	123	124	125			
	130	131	148	149	150			
	151	152	153	154	155			
	156	157	158	159	160			
	161	162	163	164	165			
	166	167	168	169	170			
	171	172	173	175	176			
	177	178	179	180	181			
	182	183	184	185	186			
	199	206	214	215	218			
	220	230	236	237	447			
	448	449	450	451	452			
	453	454	455	456	457			
	458	459	460	461	462			
	472							
R	238	239	377			Square chip resistor	RK73H1E TD 510ΩF	3
R	466	467				Square chip resistor	RK73H1E TD 61.9ΩF	2
R	433					Square chip resistor	RK73H1E TD 620ΩF	1
R	78					Square chip resistor	RK73H1E TD 62KΩF	1
R	272	273				Square chip resistor	RK73H1E TD 68ΩF	2
R	414	416				Square chip resistor	RK73H1E TD 68KΩF	2
R	434	435				Square chip resistor	RK73H1E TD 820KΩF	2
R	221	222	279	463	464	Square chip resistor	RK73H1E TD 300ΩF	6
	465							
JP	1	2	3	4	5	Square chip resistor	RK73Z1E TD 0ΩF	23
	6	7	8	9	10			
	11	12	16	17	18			
	19	25	26	27	33			
	34	35	198					
R	100	174	240	241	242	Square chip resistor	RK73H1E TD 22ΩF	14
	243	244	245	246	247			
	248	249	250	251				
R	62	373	378	379		Square chip resistor	RK73H1E TD 10ΩF	4
R	66	437	438			Square chip resistor	RK73H1E TD 2.2KΩF	3
R	79					Square chip resistor	RK73H1E TD 3.24KΩF	1
R	380					Square chip resistor	RK73H1E TD 330ΩF	1
R	129					Square chip resistor	RK73H1E TD 39KΩF	1
R	258	259				Square chip resistor	RK73H1E TD 7.15KΩF	2
R	262	263	264	441		Square chip resistor	RK73H1E TD 7.5KΩF	4
R	381					Square chip resistor	RK73H1E TD 910ΩF	1
R	365	366	367	368	369	Tantalum alloy resistance on cylinder side	TRN60LG 3.5M	8
	370	371	372					
R	412					Square chip resistor	SL1TE 10m F	1
R	440					Square chip resistor	SL1TE 1.0F	1
C	317					Electrolytic capacitor	6.3CV220AX 6.3V 220 μF	1
C	204					Electrolytic capacitor	UUD1V680MCR1GS 35V 68μF	1
C	294	301				Electrolytic capacitor	MVE35V100MF80 35V 100	2
C	179					Electrolytic capacitor	UUD1H220MCR1GS 50V 22μF	1
C	100	101	102	311	312	Electrolytic capacitor	MVE35VC220MJ10 220μF/35V	5
C	320	321				Electrolytic capacitor	35CV1500AX 35V 1500	2

Config. No.						Part name	Specification	Q'ty
C	180	181	330	331	332	Chip laminate capacitor	GRP155B11E103KA01D 25V 0.01μF	7
	333	334						
C	1	2	3	4	5	Chip laminate capacitor	GRP155F11C104ZA01D 16V 0.1μF	130
	6	7	8	9	10			
	11	12	13	14	15			
	16	17	18	19	20			
	21	22	23	24	25			
	26	27	28	29	30			
	31	32	33	34	35			
	36	37	41	42	43			
	44	45	46	47	48			
	50	51	52	53	54			
	55	56	57	58	59			
	60	61	62	63	64			
	65	66	67	68	69			
	70	71	72	73	74			
	75	76	77	78	79			
	80	81	82	83	84			
	85	86	87	88	89			
	91	92	93	94	96			
	97	98	99	159	174			
	205	238	239	240	241			
	242	243	244	245	269			
	270	271	272	273	284			
	287	288	289	290	291			
	292	293	295	323	324			
	325	326	327	335	336			
	337	338	339	340	342			
C	186	187	188	189	190	Tantalum capacitor	TESVSP1C105M8R 16V 1.0 μF	11
	191	192	193	194	195			
	196							
C	160	161	162	163	164	Tantalum capacitor	TESVSJ0J475M8R 6.3V 4.7 μF	19
	165	166	167	168	169			
	170	171	172	173	175			
	176	177	328	329				
C	38	265	266	267		Tantalum capacitor	ECST0GY226 4.0V 22 μF	4
C	90	95	278	279	280	Chip laminate capacitor	GRM188F11H104Z 50V 0.1 μF	12
	281	282	283	296	297			
	298	341						
C	285	286				Chip laminate capacitor	GRM219F11E105ZA01D 25V 1.0μF	2
C	300	305	306	307	308	Chip laminate capacitor	GJ232RF11H475ZD01 50V 4.7	6
	309							
C	220	221	222	223	224	Chip laminate capacitor	GRM1552C1H330JZ01D 50V 33PF	17
	225	226	227	228	229			
	230	231	232	233	234			
	235	236						
C	206	207				Chip laminate capacitor	GRM1552C1H101JD01D 50V 100PF	2
C	208	209	210	211	212	Chip laminate capacitor	GRM1552C1H151JA01D 50V 150PF	10
	213	214	215	216	217			
C	316					Chip laminate capacitor	GRM1552C1H221JA01D 50V 220PF	1
C	182	183	184	185		Chip laminate capacitor	GRM1552C1H471JA01D 50V 470PF	4
C	178					Chip laminate capacitor	GRP155B11H681K 50V 680PF	1
C	218	219				Chip laminate capacitor	GRM1885C1H561J 50V 560PF	2
C	197	198	199	200	201	Chip laminate capacitor	GRP155B11H102KA86D 50V 1000PF	7
	202	203						

Config. No.						Part name	Specification	Q'ty
C	237					Chip laminate capacitor	GRP155B11H222KA01D 50V 2200PF	1
C	39	40	104	115	116	Chip laminate capacitor	GRP155F11H103Z 50V 0.01μF	49
	117	118	119	120	121			
	122	123	124	125	126			
	127	128	129	130	131			
	132	133	134	135	136			
	137	138	139	140	141			
	142	143	144	145	146			
	147	148	149	150	151			
	152	153	154	155	156			
	157	158	263	264				
C	246	247	248	249	250	Chip laminate capacitor	GRP155F11A224Z 10V 0.22μF	10
	251	252	253	254	277			
C	268	274	275	276		OS capacitor	16SV15M 16V 15μF	4
C	310	313	314			Electrolytic capacitor	10CV33AX 10V 33 μF	3
Q	1	2				Silicon transistor	2SA1163G	2
Q	8	9				Transistor	2SC-2873	2
Q	13	14	15	16	17	Transistor	FMW2	9
	18	19	20	21				
Q	11	12	45	47		Digital transistor	DTC124EUA	4
Q	44					Silicon transistor	2PC4081R	1
Q	42	43	46			Digital transistor	PDTA124EU	3
Q	3	4	5	6	7	Digital transistor	PDTC124EU	11
	26	28	29	34	35			
	36							
Q	22	23	41			N-CHANEL MOSFET FET	2SK2112	3
Q	39	40				FET	2SJ529	2
Q	24					Pch MOS FET	STS7PF30L	1
Q	25					FET	PSMN010-55D	1
D	55					POWER ZENER DIODE	CRZ24	1
D	28	29	30	31	40	SBD	D3FS4A	7
	54	56						
D	26					Large-current Schottkey barrier diode	DF10SC4M	1
D	34	35	36	37	38	DUAL DIODE	1PS184	5
D	7	8	9	10	11	Ultra-nigh speed switching diode	1PS302	18
	12	13	14	15	17			
	18	19	20	21	22			
	24	57	58					
D	43	44	45	46	48	DUAL DIODE	BAS28	5
D	33					diode	BZX84-B16	1
D	27					diode	BZX84-B5V6	1
D	25					SBD	LM4050CIM3-2.5	1
D	1	2	3	4	5	SBD	SL03	9
	6	16	47	53				
X	1					Crystal oscillator	MG-5100SA-FD	1
X	2					Crystal oscillator	FX0-31FL 8MHz	1
IC	35	36				OPAMP	OPA2350EA	2
IC	14	15	16	17	49	DUAL OPAMP	LM2904PWR	6
	51							
IC	48					COMARATOR	LM339PWR	1
IC	61					COMARATOR	TLC393IPWLE	1
IC	13					Real time clock	RTC-4574SAA	1
IC	28	29				MULTIPLEXER	MAX4051CEE	2
IC	31	32				ANALOG SWITCH	MAX4521CEE	2
IC	30					ANALOG SWITCH	MAX4564EUA	1

Config. No.						Part name	Specification	Q'ty
IC	37					ADC	TLC3541DGK	1
IC	21					MOTOR DRIVER	MTD2007F	1
IC	23	24	25	26	27	OPAMP	TLC2264CPW	5
IC	1					POWER REG.	MC34063AD	1
IC	45					POWER REG.	MAX1952	1
IC	55					LAN controller	LAN91C96TQFP	1
IC	7					CPU	HD6417727F100C	1
IC	6					AND GATE	74HC08PW	1
IC	2	5	18			SCHIMITT INVERTER	74HC3G14DP	3
IC	64					BINARY COUNTER	74HC4040PW	1
IC	57					NOR GATE	SN74LV02APW	1
IC	41					BUFFER	SN74LVC1G125DBVR	1
IC	59					INVERTER	74LVC240APW	1
IC	3	58				Buffers	74LVC244APW	2
IC	19					SCHIMITT INVERTER	74AHCT14PW	1
IC	53					NAND GATE	74AHCT00PW	1
IC	56					NOR GATE	74AHCT02PW	1
IC	20	22	70			Octal Buffer	HD74ACT244TELL-L	3
IC	60					NAND GATE	SN74LV132APWR	1
IC	69					D-FF with SET/RESET	TC7W74FU	1
IC	50					Shunt regulator	uPC1093	1
IC	40					5V power supply	AN77L05M	1
IC	43					5V power supply	NJM78L05UA	1
IC	47					POWER REG.	LM2674M-5.0	1
IC	44					Charging IC	BQ2004ESN	1
IC	46					POWER REG.	LM2674M-3.3	1
IC	62					POWER REG.	S-873325BUP-ALA	1
IC	42					POWER REG.	MAX668EUB	1
IC	39					POWER REG.	TPS77133DGK	1
IC	12					SDRAM	UPD45128163G5-A75-9JF	1
IC	11					Flash ROM	TE28F640J3C-120	1
IC	8					FPGA	XC2S100E-6TQ144C	1
IC	33	34				Photo coupler	HCPL2601 #300	2
IC	4					RESET IC	M62733ML	1
IC	38					CPLD	XC9572XL-10VQ44C	1
P	6					Connector	DF13B-5P-1.25V(21)	1
P	5					Connector	DF13B-4P-1.25V(21)	1
P	1					FFC connector	00 6207 33 29 14 000 14P	1
P	3					Connector	DF13B-15P-1.25V (21)	1
P	2					Connector	DF20G-20DP-1V	1
P	4					Connector	DF13B-2P-1.25V(21)	1
LED	2	3	4	5	6	LED	SML-210MT	7
	7	8						
F	6					Fuse	451003 (125V 3A)	1
F	3					Fuse	451005(125V 5A)	1
F	2					Fuse	TF16N 0.25	1
F	1					Fuse	TF16N 0.50	1
NF	1	3				Arrestor	RCCA-201Q31UA	2
NF	2					Chip solid EMI-FIL	NFM2012P13C474F	1
L	3	4	5	6	7	Chip ferrite beads	BLM18RK102SN1	21
	8	9	10	11	12			
	13	14	15	16	17			
	18	19	20	21	28			
	35							

Config. No.						Part name	Specification	Q'ty
L	29	30	31	34	36	Chip ferrite beads	BLM15AG102SN1	9
	37	38	39	40				
L	2	22	23			Chip inductor	LFC32TE 101K	3
RM	1	2	3	4		Chips assembled rediditor,8ships	EXBD10C103J	4
L	1					inductor	LPC4045TE 101K 100μH	1
L	24	25	26	27		inductor	CDRH127/LD-680MC 68uH	4
L	33					inductor	CDRH127/LD-820MC 82uH	1
L	32					inductor	CDRH2D18/HP-2R2NC 2.2uH	1
T	3	4				Common-mode choke coil	DLW31SN222SQ2	2
						Board	PCB-6950	1
C	255	256	257	258	259	Capacitor	MMT50J-105-0117 1μF	8
	260	261	262					
VR	1					Variable resistor	V105-4PVN 10KΩ	1
J	1					Power jack	2DC-0005D100	1
P	8					Connector	B4P-VH	1
J	3					Connector	RDAG1-15SE1(F)	1
J	2					LAN connector	TM11R-5C-88	1
JP	31	37	38	39		JUMPER	WL-1-2P	4
Y	1					Buzzer	PKM13EPP-4002	1
T	2					Transformer	PE-65421	1
BT	1					Lithium battery(vertical type)	CR2032 TVA	1
T	1					Pulse transformer	FT-2155	1

KEY BOARD (PCB-6949)

Config. No.	Part name	Specification	Q'ty
LED 1	LED(blue)	KA-3528MBC	1
LED 2	LED(blue, yellow)	KA-3528MBYC	1
P 1	connector	DF20G-20DP-1V	1
SW 1 2 3 4 5 6 7 8 9	Tact switch	SKRAAAE010	9
	Board	PCB-6949	1

SENSOR BOARD (PCB-6948)

Config. No.			Part name	Specification	Q'ty
LED	1	2	Photo sensor	EE-SY125	2
			Board	PCB-6948	1
P	1		Connector	DF4-5P-2C	1

MAG UP BOARD (PCB-6951)

Config. No.	Part name	Specification	Q'ty
SW 1	Detection switch	SPVC2-1	1
	Board	PCB-6951	1
P 1	connector	DF4-2P-2C	1

Other spare parts list

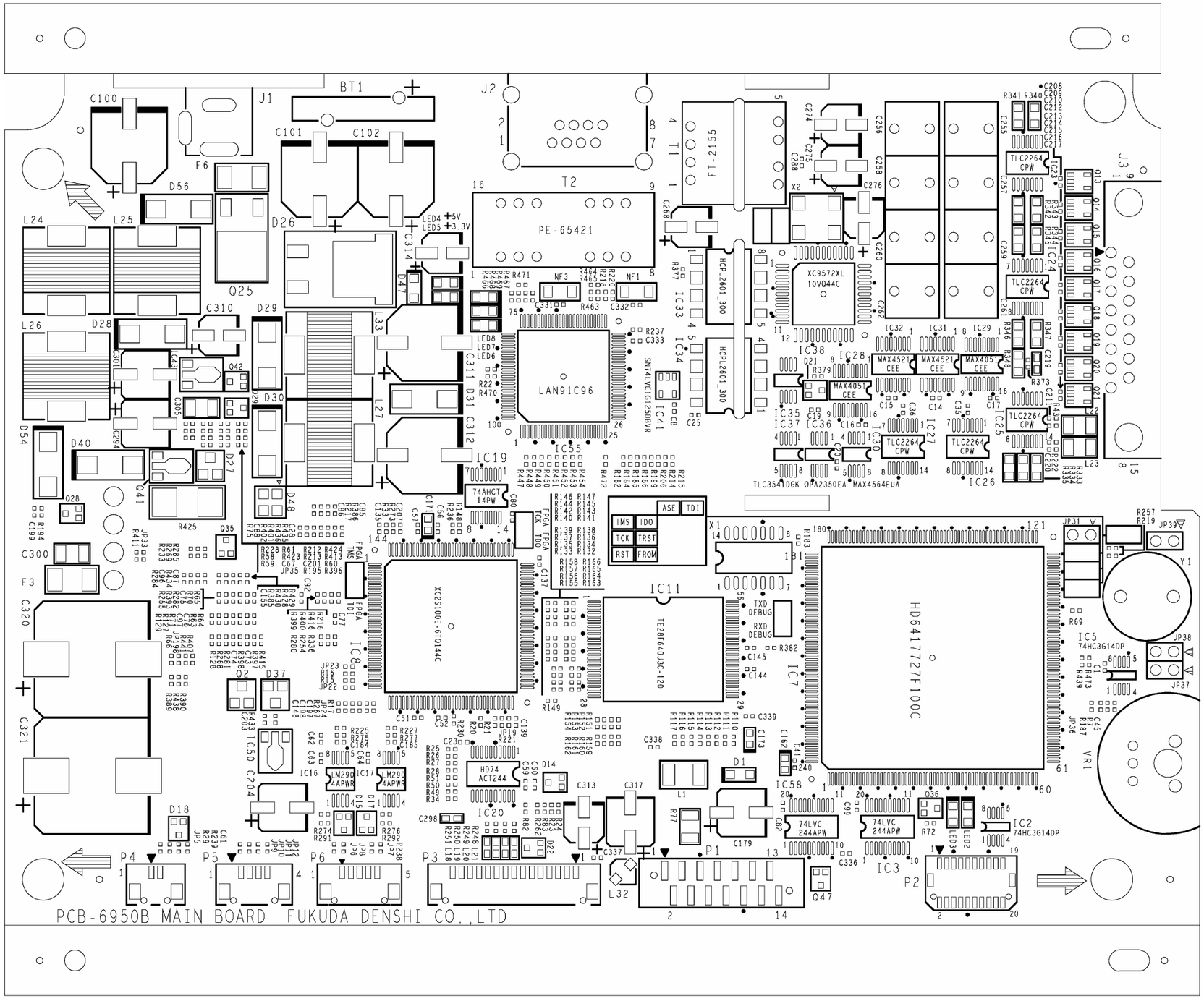
Config. No	Part name	Specification	Q'ty
1L1778	LCD module	LMAGAR032J60K	1
1G9458	Operation panel	FX-7102(General export) Operation panel	1
1W3105	Thermal head	AE056-8E803	1
1Y1203A	Motor	PFC25-24Q1G(1/50)-02	1
1M1294	Harness	FX-7102(General export) Thermal cable	1
9E3846	MARK SENSOR ASSY	FX-7102(General export)MARK SENSOR ASSY	1
9E3847A	MAG UP SENSOR ASSY	FX-7102(General export)MAG UP SENSOR ASSY	1
9D6315	AC adapter	OA-467	1
1U0037	Battery	8PH-4/3A3700-H-J18	1
1U0243	Lithium battery	CR2032 TVA	1

Chapter 7

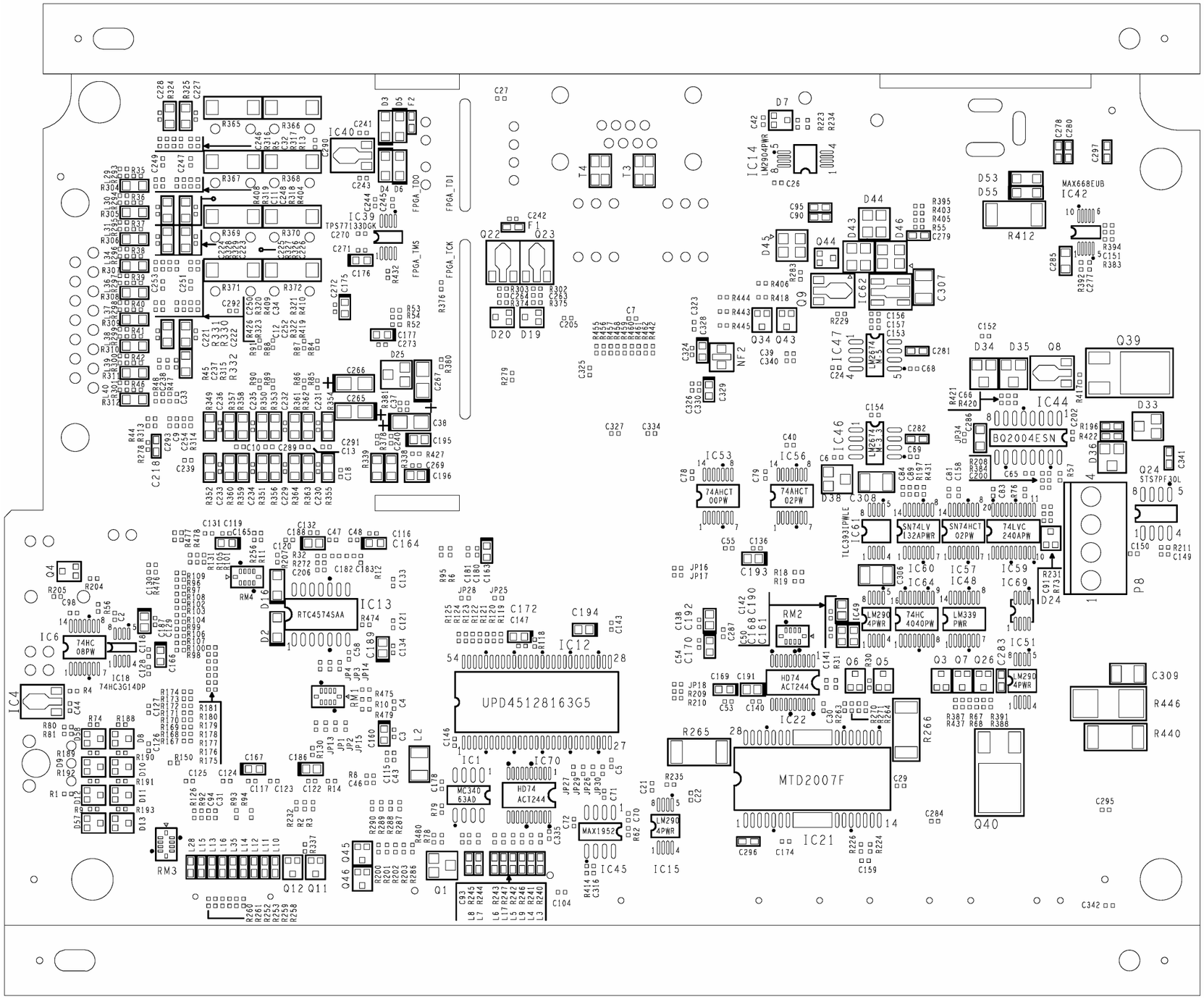
Board Component Diagram

MAIN BOARD (PCB-6950component side) 7-1
MAIN BOARD (PCB-6950soldering side)..... 7-2
KEY BOARD (PCB-6949component side) 7-3
KEY BOARD (PCB-6949soldering side) 7-4
SENSOR BOARD (PCB-6948component side) 7-5
MAG UP BOARD (PCB-6951component side) 7-6

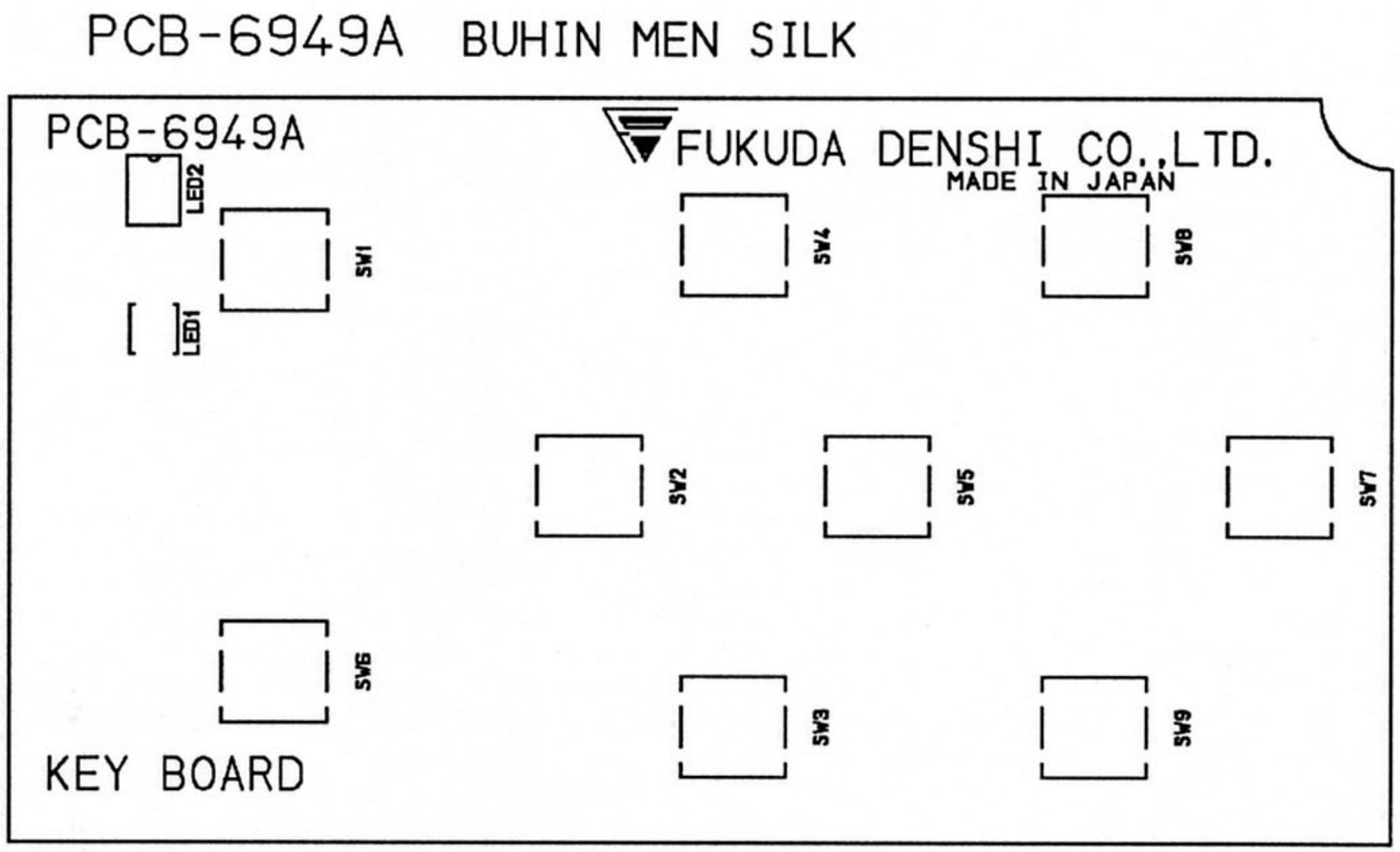
MAIN BOARD (PCB-6950 component side)



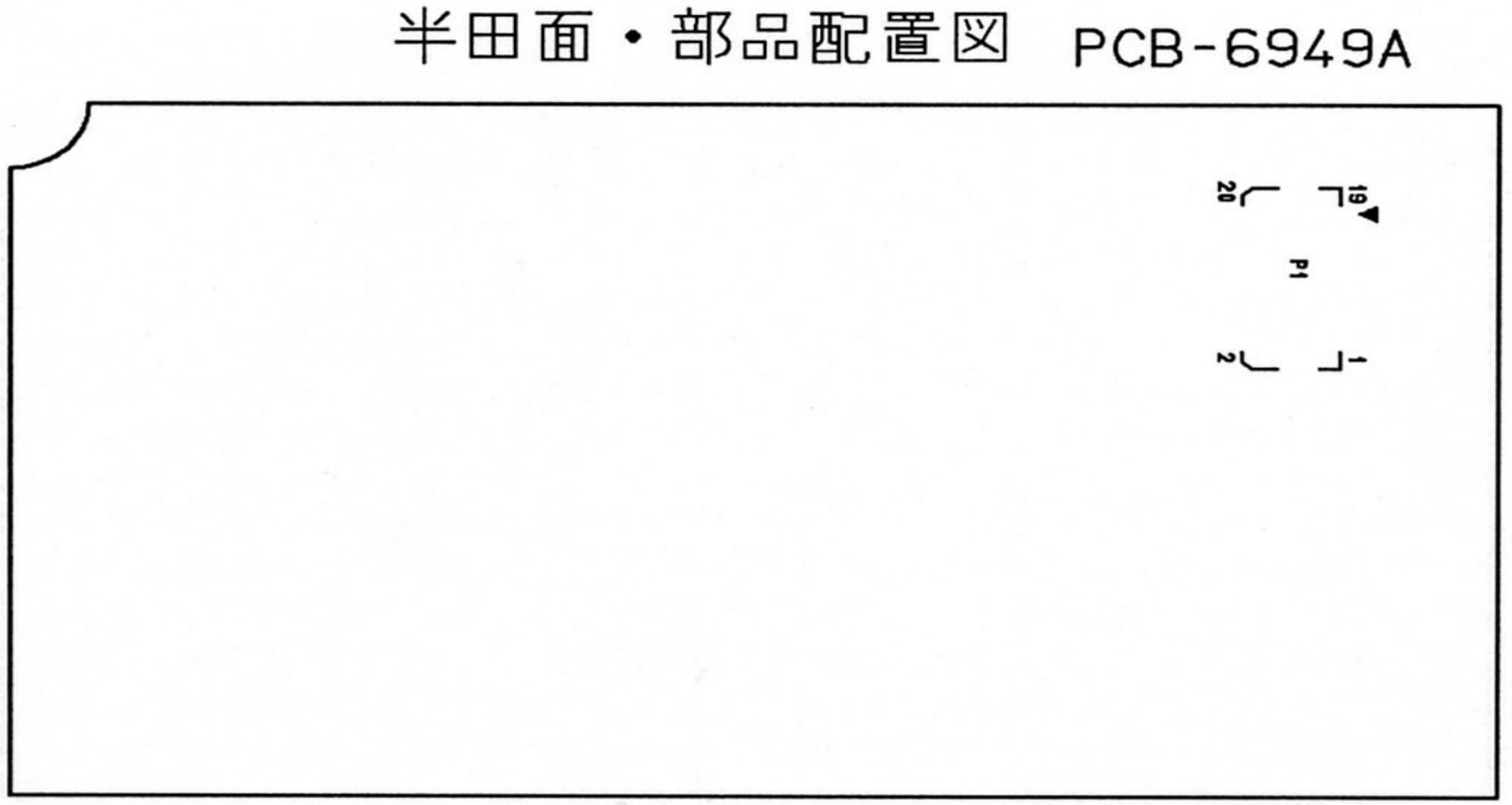
MAIN BOARD (PCB-6950 soldering side)



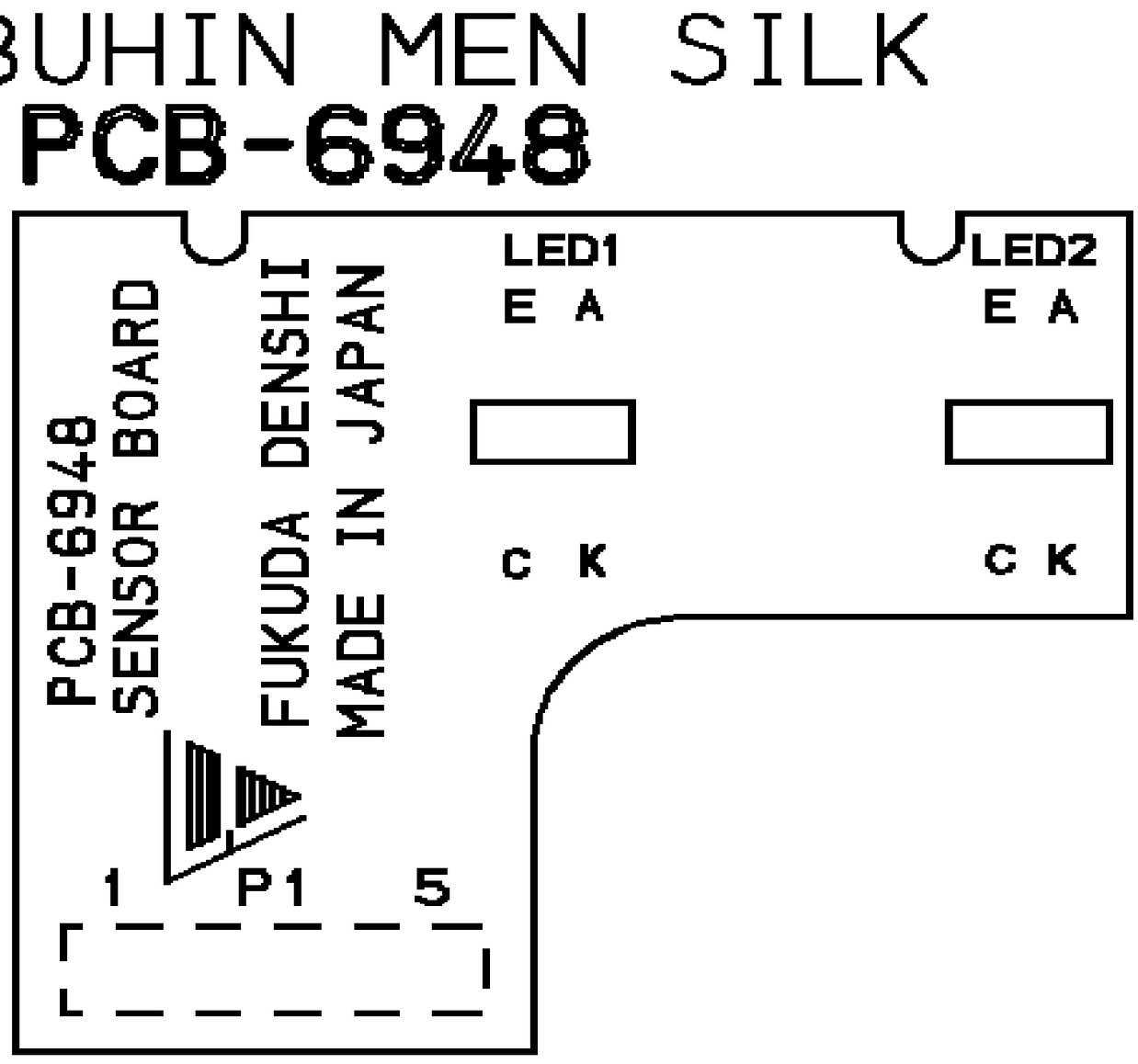
KEY BOARD (PCB-6949 component side)



KEY BOARD (PCB-6949 soldering side)



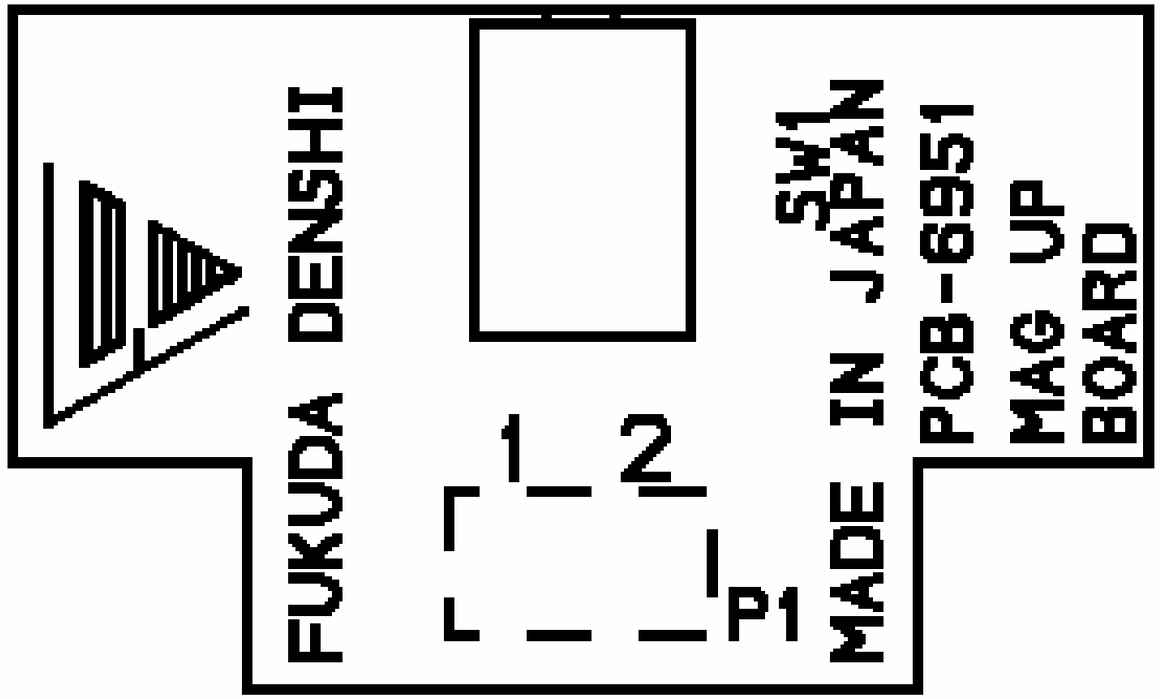
SENSOR BOARD (PCB-6948 component side)



MAG UP BOARD (PCB-6951 component side)

BUHIN MEN SILK

PCB-6951

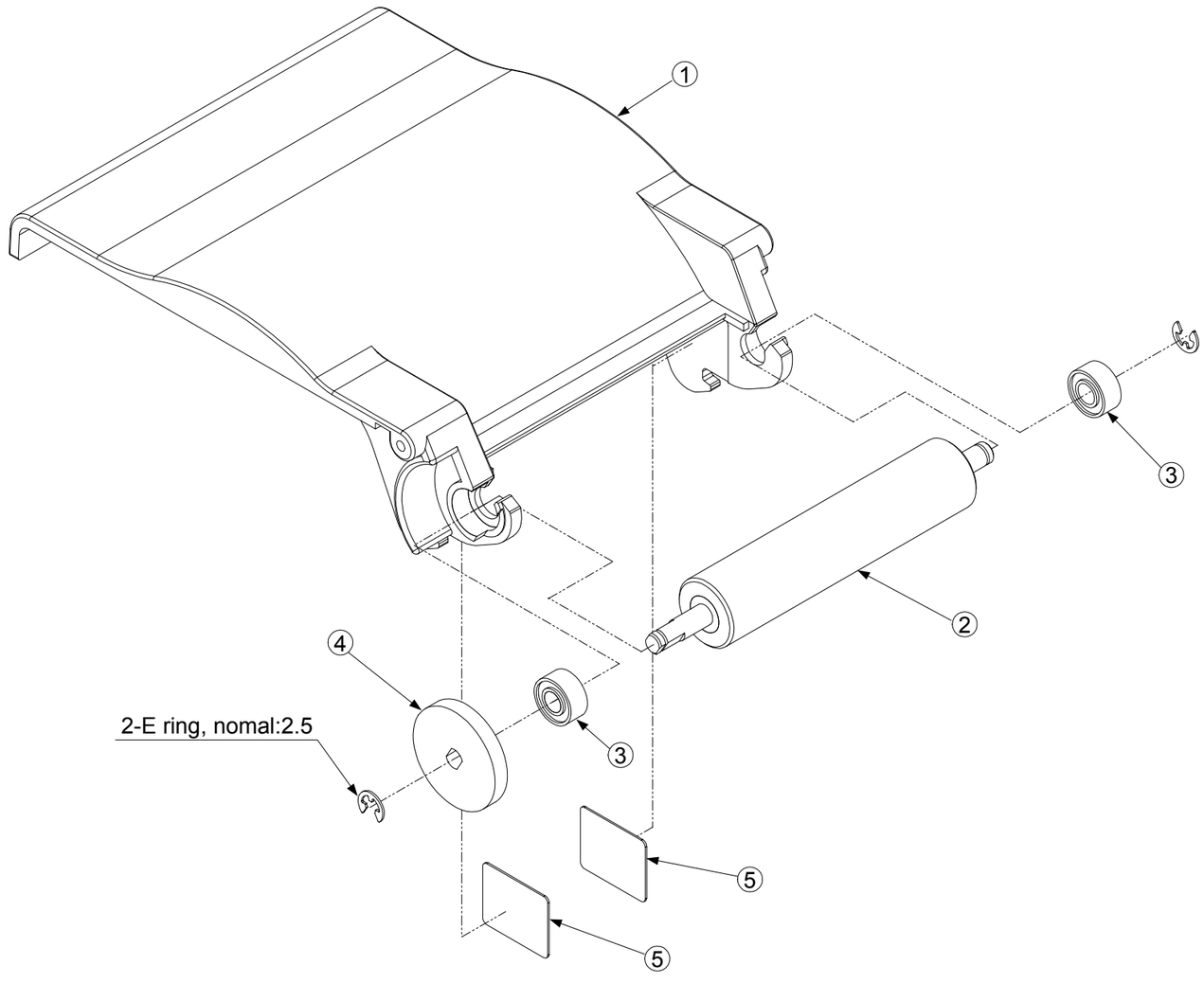


Chapter 8

Assembly Diagrams

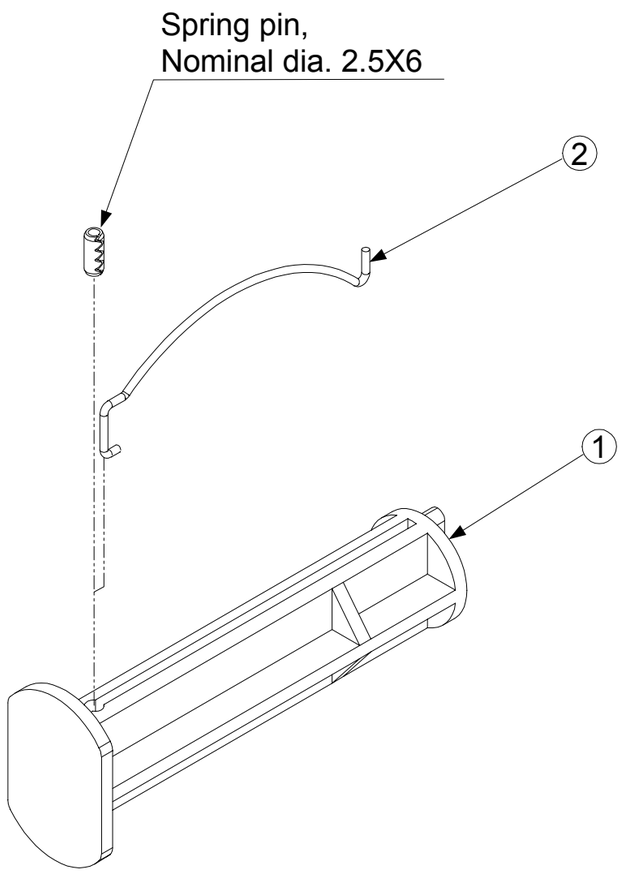
Magazine 8-1
Paper shaft 8-2
Recorder 8-3
Upper case (FX-7102) 8-4
Upper case (FCP-7101) 8-5
Lower case 8-6
General assembly diagram (FX-7102) 8-7
General assembly diagram (FCP-7101) 8-8
Outline view (FX-7102) 8-9
Outline view (FCP-7101) 8-10
Paper guide 8-11
50mm Magazine adapter (Option) 8-12
50mm Paper adapter (Option) 8-13

Magazine



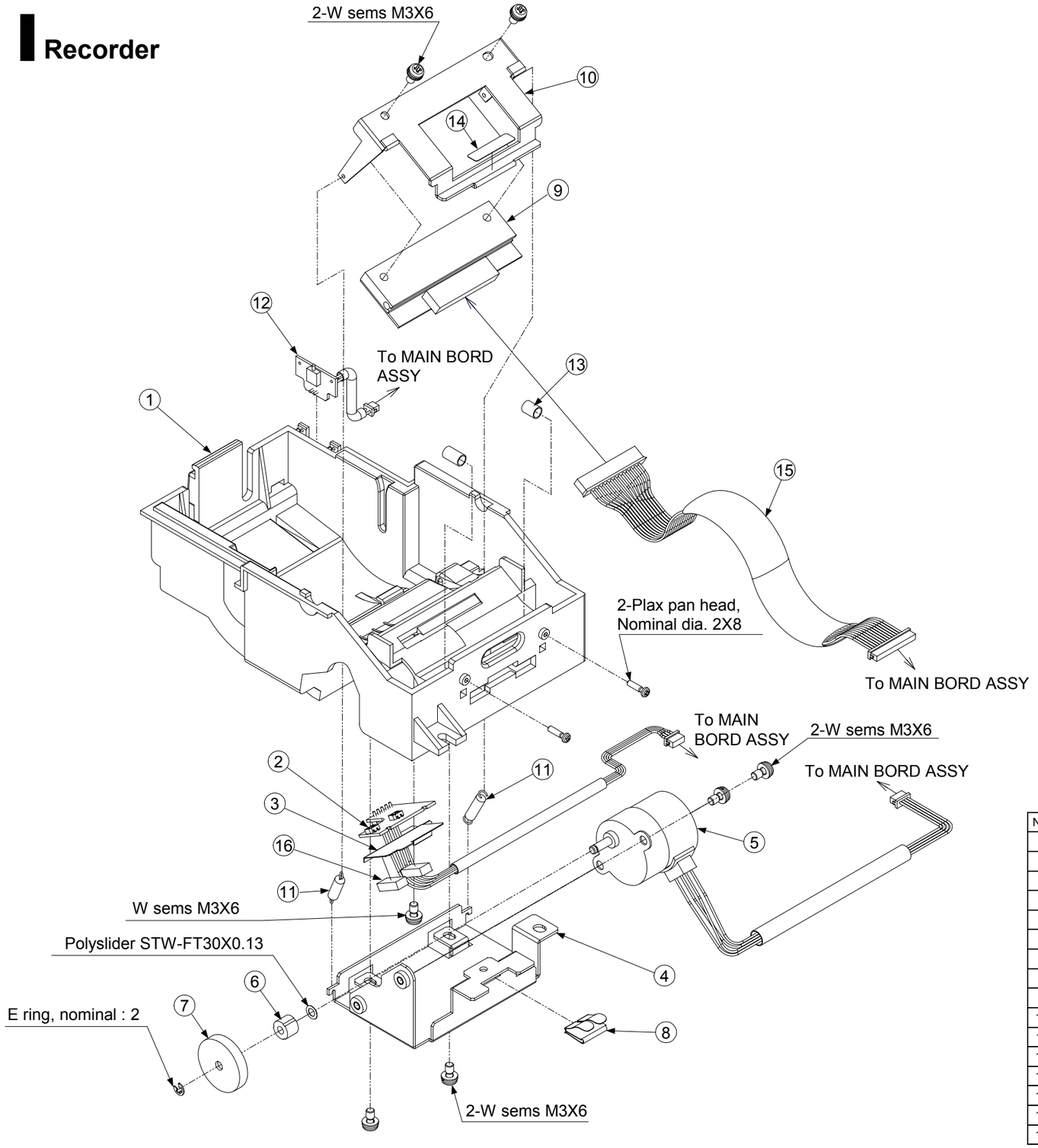
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	6C9023	310-8597	Magazine	1	
2	6C9025	310-8598	Platen roll	1	
3	6C9024		Bearing DLL-940ZZ	2	Commercial item
4	6C9026	310-8599	Platen Gear	1	
5	6C9027	310-8600	Magazine protective plate	2	

Paper shaft



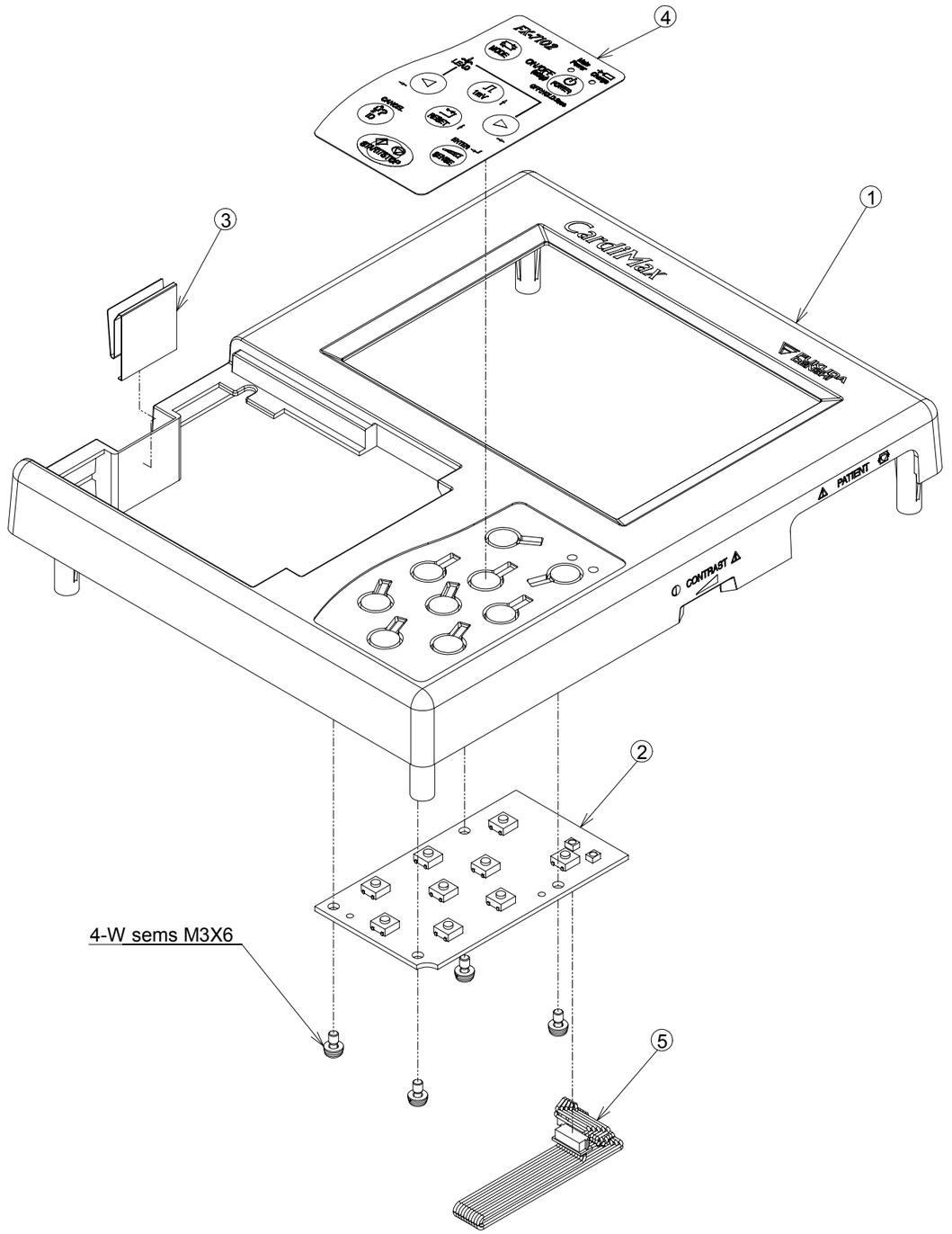
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	6C9022	310-8595	Paper shaft	1	
2	6C9179	310-8880	Back tension spring	1	

Recorder



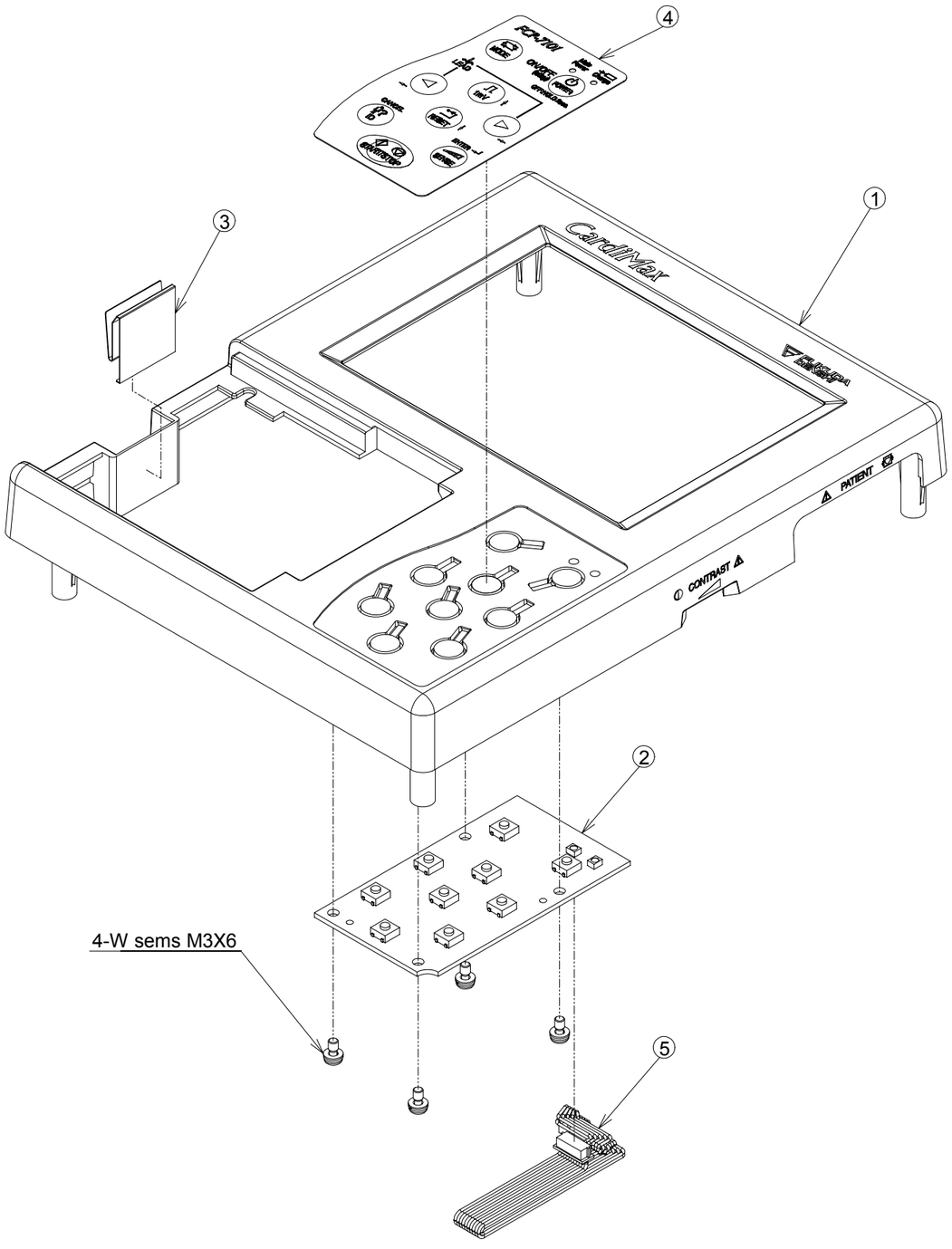
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	9H6765	310-8589	Recoder chassis SU	1	
2	9E3846		Mark sensor assy	1	
3	6C9019	310-8593	Mark sensor mounting bracket	1	
4	9H6766	310-8590	Motor mounting bracket	1	
5	1Y1203A	680-4443	Motor PFC25-24Q1G (1/50)-02	1	
6	6C9021		One-way clutch OWC-307GXRZ	1	Commercial item
7	6C9020	310-8594	Motor guide	1	
8	6B9217	314-3603	Shield finger (A)	1	Common with FX-2111
9	1W3105	680-4442	Thermal head AE056-8E803	1	
10	6C9017	310-8591	Head mounting bracket	1	
11	6C9018	310-8592	Head tension spring	2	
12	9E3847A		MAG UP sensor assy	1	
13	6C9178	310-8879	Head compression spring	2	
14	6C9180	310-8881	Recorder protective seal	1	
15	1M1277	310-8571	Thermal cable	1	
16	9C9176	310-8878	LCD presser sponge	2	

Upper case (FX-7102)



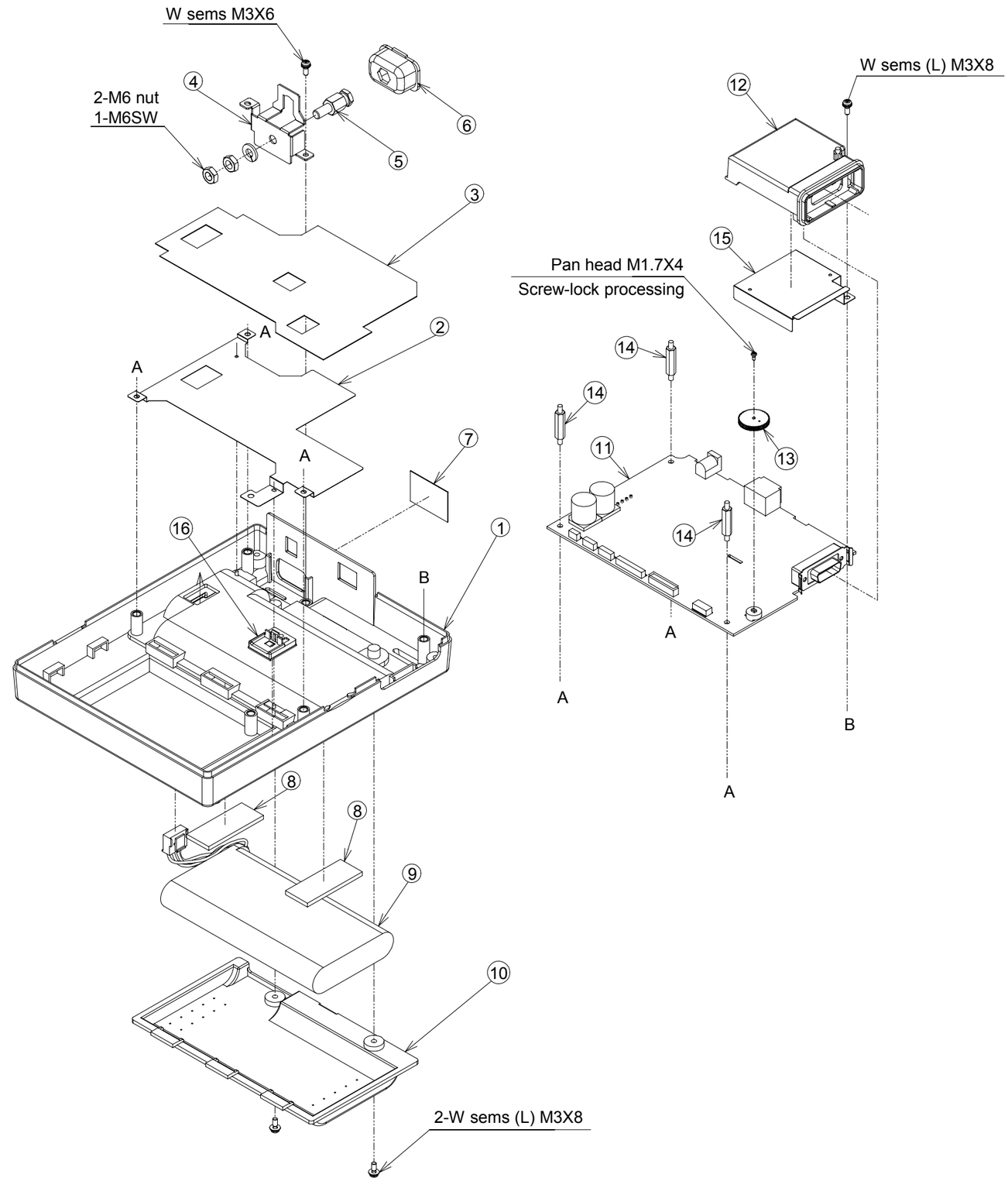
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	5G2191	310-8574	Upper case U	1	
2	9F5379A		Key board	1	
3	6C9147	310-8876	Lock spring	1	
4	5G2192	310-8576	FX-7102 Operation panel sheet (English)	1	
5	1M1294	310-8564	KEY cable	1	

Upper case (FCP-7101)



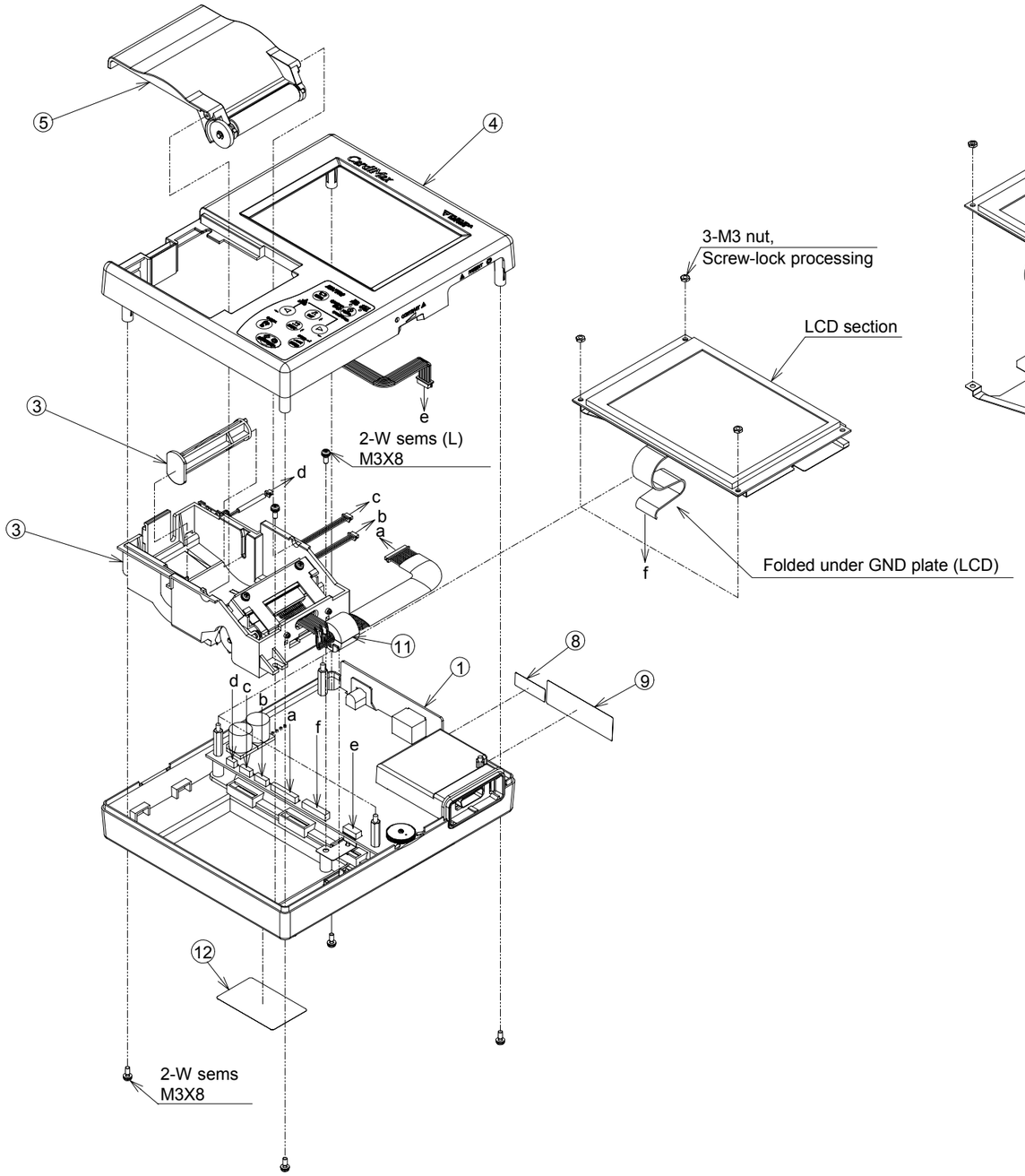
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	5G2191	310-8574	Upper case U	1	FX-7102 (Export) Common
2	9F5379A		Key board	1	FX-7102 (Export) Common
3	6C9147	310-8876	Lock spring	1	FX-7102 (Export) Common
4	5G2197	310-8608	FCP-7101 Operation panel sheet (English)	1	
5	1M1294	310-8564	KEY cable	1	FX-7102 (Export) Common

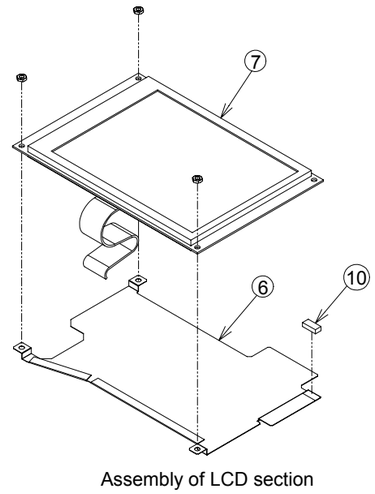
Lower case



No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	9H6764	310-8577	Lower case SU	1	
2	6C9008	310-8581	GND plate	1	
3	6C9009	310-8582	Insulation sheet	1	
4	6C9007	310-8580	GND terminal mounting bracket	1	
5	6C9006	310-8579	GND terminal	1	
6	6C9005	310-8578	GND terminal cover	1	
7	5G2193	310-8602	Nameplate connector	1	
8	6C9011	310-8584	Battry pressing sponge	2	
9	1U0337	680-4469	Battry 8PH-4/3A3700-H-J18	1	
10	6C9010	310-8583	Battry cover	1	
11	9F5380		Main board assy	1	
12	6C9014	310-8587	Isolation case	1	
13	6C9013	310-8586	Volume knob	1	
14	6C9108	310-8585	M3 hexagon bar (L=19.7)	3	
15	6C9175	310-8877	ECG shield plate	1	
16	6C9177		Core fastening device TFB-2024A	1	Commercial item

General assembly diagram (FX-7102)

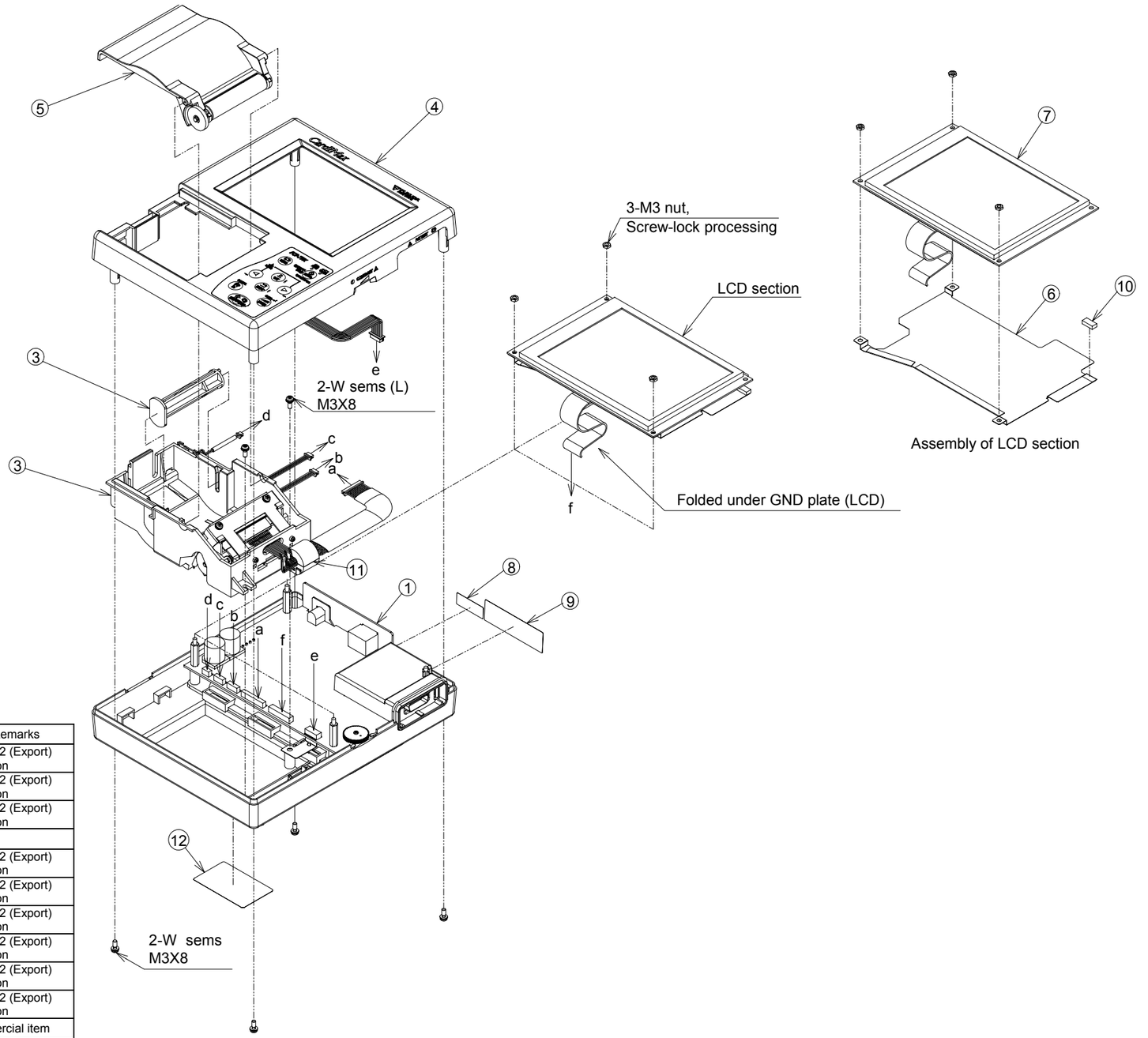




Assembly of LCD section

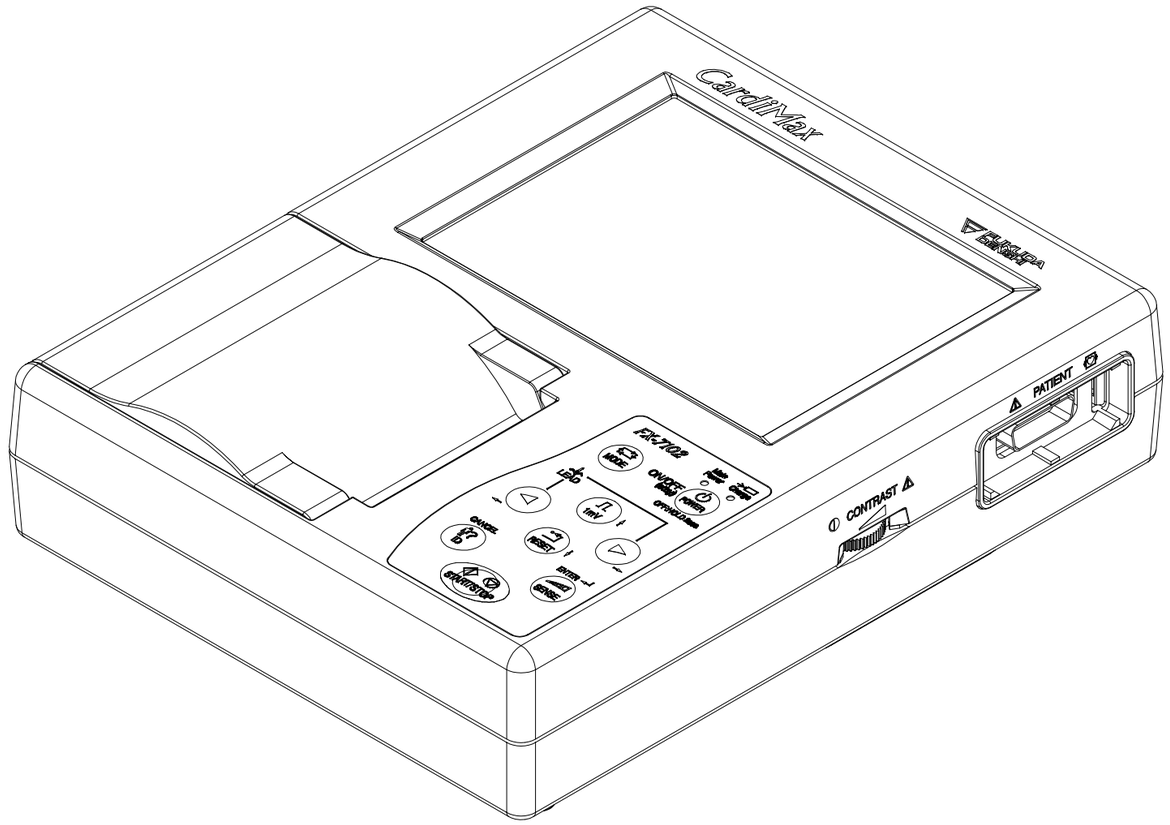
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1		410-2537	Lower case unit assembly diagram	1	
2		410-2535	Recorder unit assembly diagram	1	
3		410-2534	Paper shaft unit assembly diagram	1	
4		410-2536	Upper case unit assembly diagram	1	
5		410-2533	Magazine unit assembly diagram	1	
6	6C9107	310-8588	GND plate (LCD)	1	
7	1L1778	680-4441	LCD module	1	
8	5G2194	310-8603	CE mark: Beijing (With ID, 7 mm)	1	
9	5G2195	310-8604	Caution plate (FDA)	1	
10	6C9176	310-8878	LCD presser sponge	1	
11	1T7094		Core TFT-081813N	1	Commercial item
12	9E9786		Rating plate	1	

General assembly diagram (FCP-7101)

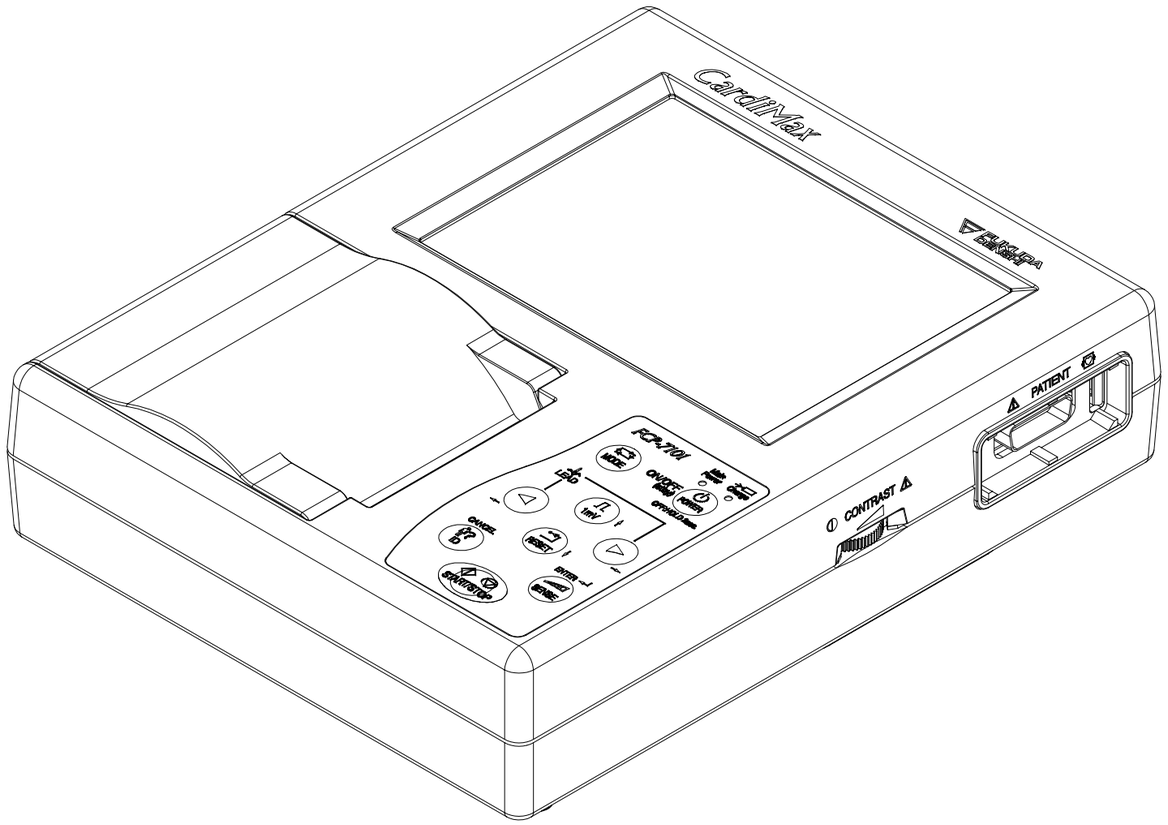


No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1		410-2537	Lower case unit assembly diagram	1	FX-7102 (Export) Common
2		410-2535	Recorder unit assembly diagram	1	FX-7102 (Export) Common
3		410-2534	Paper shaft unit assembly diagram	1	FX-7102 (Export) Common
4		410-2529	Upper case unit assembly diagram	1	
5		410-2533	Magazine unit assembly diagram	1	FX-7102 (Export) Common
6	6C9107	310-8588	GND plate (LCD)	1	FX-7102 (Export) Common
7	1L1778	680-4441	LCD module	1	FX-7102 (Export) Common
8	5G2194	310-8603	CE mark: Beijing (With ID, 7 mm)	1	FX-7102 (Export) Common
9	5G2195	310-8604	Caution plate (FDA)	1	FX-7102 (Export) Common
10	6C9176	310-8878	LCD presser sponge	1	FX-7102 (Export) Common
11	1T7094		Core TFT-081813N	1	Commercial item
12	9E9839		Rating plate	1	

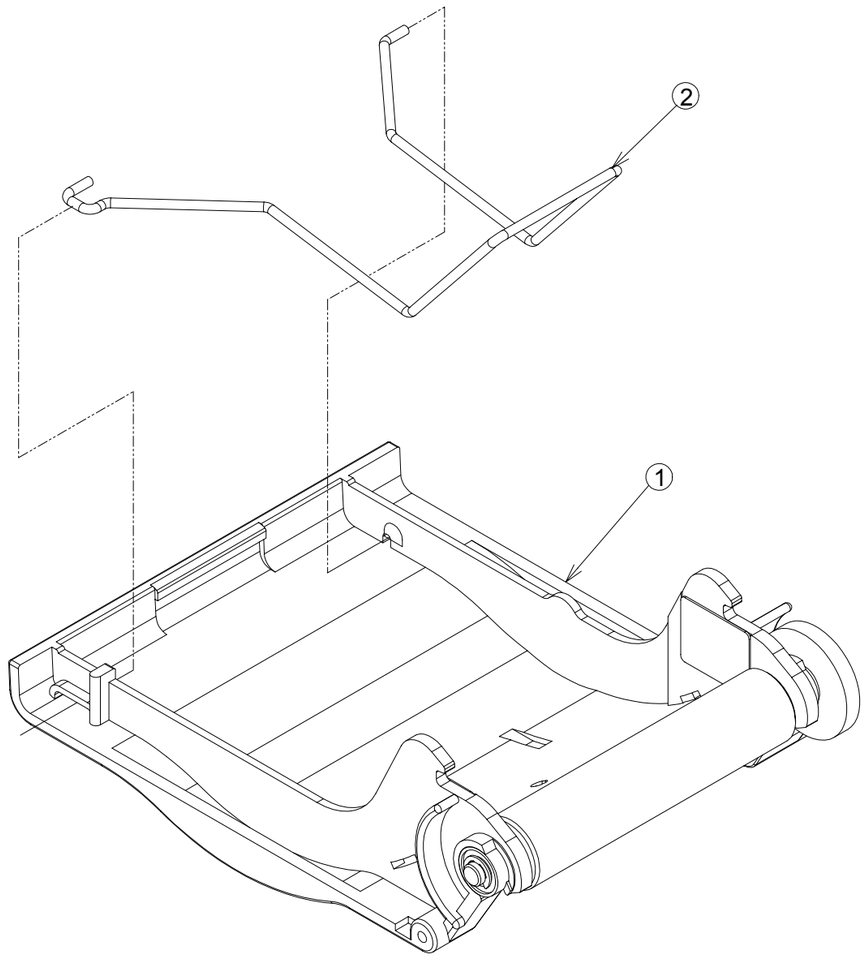
Outline view (FX-7102)



Outline view (FCP-7101)

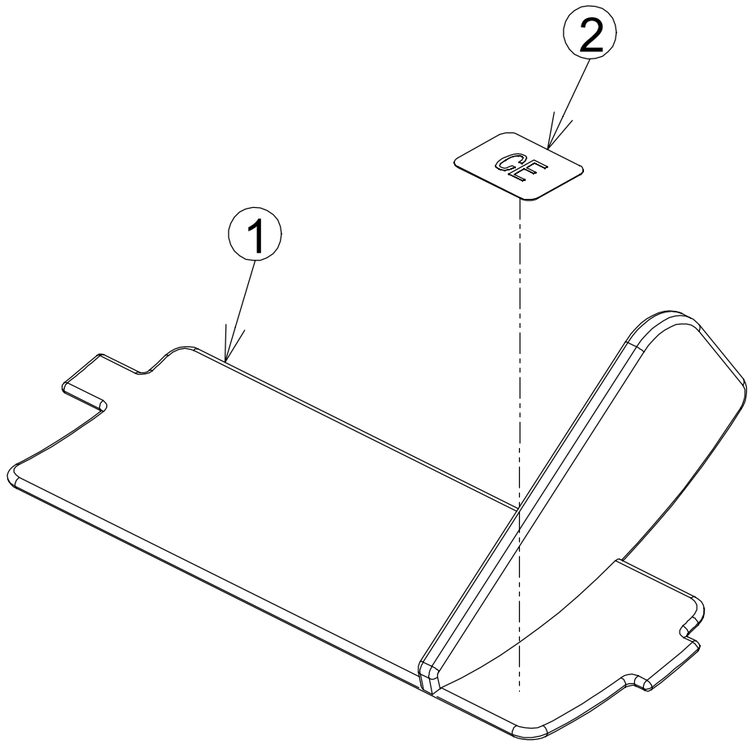


Paper guide



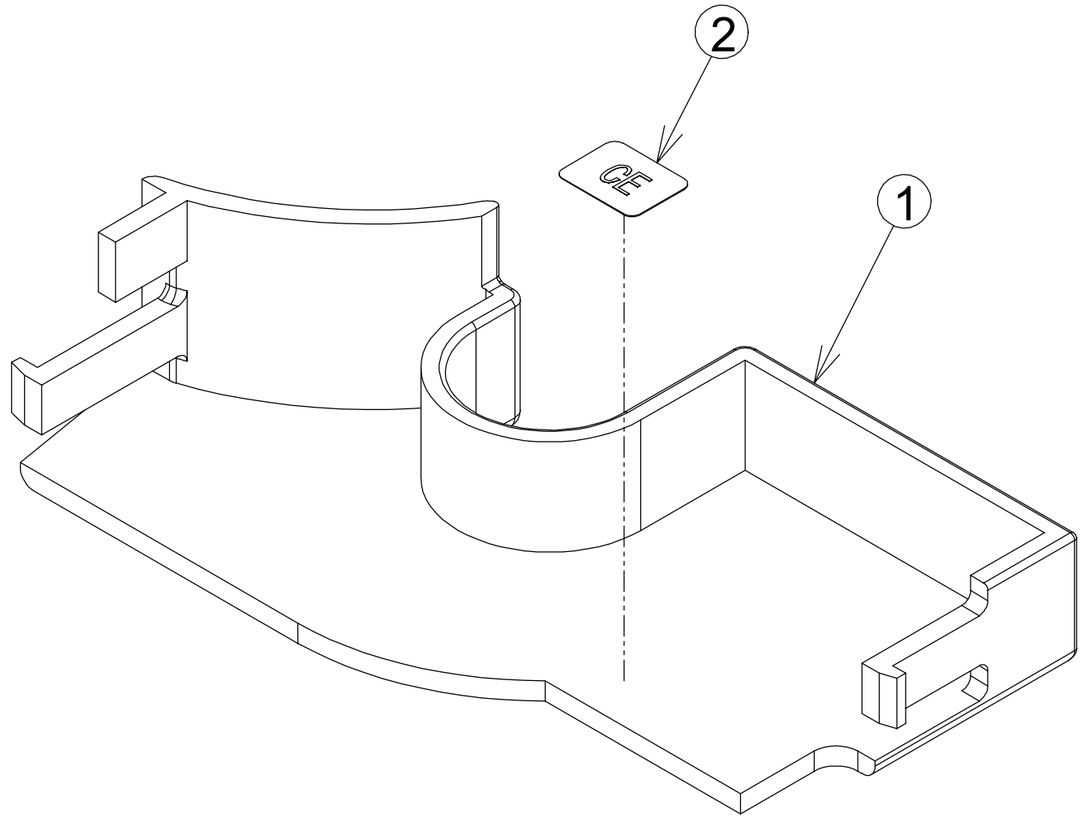
No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1		410-2533	Magazine unit assembly diagram	1	
2	6C9028	310-8601	Paper guide	1	

50mm Magazine adapter (Option)



No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	6C9103	310-8606	50-mm magazine adapter	1	
2	5H9673	154-4914	CE mark label (Small)	1	HB-500 (General export) Common

50mm Paper adapter (Option)



No.	Part No.	Drawing No.	Name and type	Q'ty	Remarks
1	6C9104	310-8607	50-mm paper adapter	1	
2	5H9673	154-4914	CE mark label (Small)	1	HB-500 (General export) Common

Chapter 9

Technical Instructions Related to EMC

Emission information CISPR11 9-2

Immunity information (to other than radiation/conduction) 9-3

Immunity information (to radiation/conduction) 9-4

Recommended distance of separation from portable telephone, etc. 9-5

Chapter 9 Technical Instructions Related to EMC

This chapter concerns 4 different information as appended documents Required by IEC 60601-1-2.

(1) Emission information CISPR11
(2) Immunity information (to other than radiation/conduction)
(3) Immunity information (to radiation/conduction)
(4) Recommended distance of separation from portable telephone, etc.

Emission information CISPR11

The following shows a declaration related to CISPR11.

<table>
<tr><th colspan="3">Guidance and declaration by manufacturer-Electromagnetic emission-CISPR11</th></tr>
<tr><td colspan="3">The equipment is intended to be used in the electromagnetic environment designated below.
Client or user of the equipment is requested to confirm the equipment will be operated in such environment.</td></tr>
<tr><td>Emission test</td><td>Conformity</td><td>Guidance for electromagnetic environment</td></tr>
<tr><td>RFemission
CISPR11</td><td>Group1</td><td>The equipment uses RF energy for internal functions of devices. Therefore, the RF emission is not so intense as to cause interference with nearby electronic devices.</td></tr>
<tr><td>RFemission
CISPR11</td><td>Class [B]</td><td rowspan="3">The equipment is usable in all constructions such as general household constructions and buildings intended for general household purpose which are directly connected to low-voltage commercial-frequency power supply network.</td></tr>
<tr><td>Harmonics
emission
IEC 61000-3-2</td><td>Class [A]</td></tr>
<tr><td>Power
fluctuation/flicker
emission
IEC 61000-3-3</td><td>Yes</td></tr>
</table>

Immunity information (to other than radiation/conduction)

The following is a declaration related to the electromagnetic immunity of the equipment.

Guidance and declaration by manufacturer-Electromagnetic emission-CISPR14			
The equipment is intended to be used in the electromagnetic environment designated below. Client or user of the equipment is requested to confirm the equipment will be operated in such Environment.			
Immunity test	IEC 60601 test level	Conformity level	Guidance for electromagnetic environment
Electrostatic discharge (ESD) IEC 61000-4-2	±6kV in contact. ±8kV in air.	±6kV in contact. ±8kV in air.	The floor must be wood, concrete or ceramic tiles. If the floor is covered with synthetic material, the relative humidity must be at least 30%.
Electrical first transient/burst IEC 61000-4-4	±2kV against power supply line., ±1kV against input/output line.	±2kV against power supply Line. ±1kV against input/output Line.	The quality of main source must be the same as standard commercial use or hospital environment.
Surge IEC 61000-4-5	±1kV in differential mode. ±2kV in common mode.	±1kV in differential mode. ±2kV in common mode.	The quality of main source must be the same as standard commercial use or hospital environment.
Voltage dip, short-time failure and voltage fluctuation on power supply input line IEC 61000-4-11	<5%U_T (drop>95%U_T) for 0.5 cycle. 40%U_T (drop 60%U_T) for 5 cycle. 70%U_T (drop 30%U_T) for 25 cycle. <5%U_T (drop >95%U_T) for 5 seconds.	<5%U_T (drop>95%U_T) for 0.5 cycle. 40%U_T (drop 60%U_T) for 5 cycle. 70%U_T (drop 30%U_T) for 25 cycle. <5%U_T (drop >95%U_T) for 5 seconds.	The quality of main source must be the same as standard commercial use or hospital environment. If user of the equipment requires a continuous operation even during failure of main source, use of uninterruptible power supply or battery is recommended as power source for the equipment.
Magnetic field intensity of source frequency (50/60Hz) IEC 61000-4-8	3 A/m	3 A/m	The magnetic field intensity of source frequency must be comparable to the level characteristics of the magnetic field in standard commercial or hospital environment.
Note: As U_T, AC main source voltage has the precedence of applied test level.			

Immunity information (to radiation/conduction)

The following is a declaration related to the electromagnetic immunity of the equipment.

<table>
<tr><th colspan="4">Guidance and declaration by manufacturer-Electromagnetic emission-Other than life support system</th></tr>
<tr><td colspan="4">The equipment is intended to be used in the electromagnetic environment designated below.
Client or user of the equipment is requested to confirm the equipment will be operated in such Environment.</td></tr>
<tr><td>Immunity test</td><td>IEC 60601 test level</td><td>Conformity level</td><td>Guidance for electromagnetic environment</td></tr>
<tr><td>ConductedRF
IEC 61000-4-6

RadiatedRF
IEC 61000-4-3</td><td>3V_{RMS}
150kHz to 80MHz

3V/m
80MHz to 2.5GHz</td><td>3V

3V/m</td><td>Any of portable and mobile RF communication devices must not be used within the recommended distance of separation from any part of the equipment as calculated by an equation corresponding to the transmitter frequency.

Recommended distance of separation
$d = 1.2\sqrt{P}$

$d = 1.2\sqrt{P}$ 80MHz～800MHz

$d = 2.3\sqrt{P}$ 800MHz～2.5GHz

where P is the rated output power in W of the transmitter specified by its manufacturer, and d is the recommended distance of separation in m.

The electric field intensity from fixed RF transmitter determined by an investigation of field electromagnetism [(a)] must be lower than the conformity level at each frequency band [(b)]

Interference may occur in the vicinity of a device where the following symbol is indicated.
 </td></tr>
<tr><td colspan="4">Note 1. In case of 80MHz and 800MHz, apply a high frequency range.

Note 2. The guideline does not apply to all circumstances. The electromagnetic diffusion is affected by reflection and absorption by structure, thing and person.</td></tr>
</table>

a It is impossible to accurately and theoretically estimate the electric field intensity from a stationary sending station such as radio telephone base station (cord-less), local portable radio station, amateur radio station, AM/FM radio broadcasting station and at TV base station. For correctly judging the environment of electromagnetism due to stationary RF sending station, proceed to field electromagnetism investigation. If the electric field intensity recorded at a site where the equipment is used exceeds the above applied RF conformity level, watch the equipment to verify whether it operates properly or not. If its operation is found abnormal, the equipment may have to be modified to match, be moved to another place or be subjected to supplementary means.

b The electric field intensity must be 3 V/m or less over the entire frequency band of 150 MHz to 80 MHz.

Recommended distance of separation from portable telephone, etc.

The following shows the recommended distance of separation of the equipment from portable or mobile RF communication devices.

Recommended distance of separation of equipment from portable or mobile RF communication devices

The equipment is intended to be used in the electromagnetic environment where the RF interference is regulated. Client or user of the equipment can suppress the electromagnetic interference by controlling the minimum distance between portable or mobile RF communication device (transmitter) and this equipment as recommended below based on the maximum output of the sending device.

Maximum rated power output in W of transmitter	Separate distance due to frequency of transmitter		
	26MHz to 80MHz $d = [\frac{3.5}{V_1}]\sqrt{P}$	80MHz to 800MHz $d = [\frac{3.5}{E_1}]\sqrt{P}$	800MHz to 2.5GHz $d = [\frac{7}{V_1}]\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

In case of maximum rated power output not listed above, recommended distance of separation d in terms of meters (m) can be determined by an equation corresponding to the transmitter frequency. In the equation, P is the maximum rated power output in Watts (W) of transmitter.

Note 1. In case of 80MHz and 800MHz, apply a high frequency range.

Note 2. The guideline does not apply to all circumstances. The electromagnetic diffusion is affected by reflection and absorption by structure, thing and person.

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